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BIRD'S-EYE VIEWS.

BY DR. ELLIOTT COUES, U. S. A.

Birds alone, of all animate beings, may be truly said to "fall asleep" in death. When the silver cord of a bird's life is loosened, the "windows of the soul" are gently closed by unseen hands, that the mysterious rites attending the divorce of the spirit from the body may not be profaned by prying looks. With us, the first office rendered by sorrowing friends to one departed, is to close the eyes, to hide from view the mockery of life that looks out from between motionless lids. And when any mammal expires, the eyes remain wide open. With all, the stony stare of the glazed ball is the sign of dissolution. Only birds close their eyes in dying.

This is one of the differences between birds and mammals. Beautiful and wonderful as birds are in this respect, which comes to the reflective mind fraught with significance, we shall find them scarcely less beautiful and wonderful even as regards the material, physical structure of their eyes. Let us look into a bird's eye. Though the flash and glow of life be gone, and only dead tissues left, we shall still find more than we can fully comprehend, and everything that we see will excite interest and admiration.

To commence by saying that all birds have eyes, might appear at first sight to be superfluous. Yet this statement expresses one of the characters of the class *Aves;* for it is not applicable, without some qualification, to any other class of Vertebrates. Some representatives of each of the other classes either have no eyes at all or else very rudimentary ones. There are blind fishes and blind reptiles; and there are mammals at least "as blind as a mole." Among birds, the "wingless" species of New Zealand (*Apteryx*) are said to have the smallest eyes of all, and also to want one of the most characteristic structures of the avian eye-type,—the marsupium, a peculiar organ inside the eye, of which we shall learn something before we have finished our "Views."

We will examine first the accessory structures of a bird's eye,—those that surround and defend it, produce its movements, and keep it in working order; and then we will look at the more exquisite mechanism within.

If we hold a dying bird in our hands, we observe that just as the last convulsive shiver agitates its frame, the eyes close by the uprising of the lower lid. In the primitive theatres of classic days, the curtain was lowered from the top to disclose the stage, and drawn up when the act was over; now these movements are reversed. Birds follow the classic usage, when the curtain rises upon the last scene of their life. Here at the outset is one difference between the eye of a bird and that of a mammal; and differences will multiply as we proceed.

The movements of the upper lid, in almost all birds, are much more restricted than those of the lower. There are few exceptions to this rule, and these chiefly furnished by the nocturnal raptores (*Owls*, *Strigidæ*), and certain fissirostres (*Caprimulgidæ*, e. g., Whippoorwill, Night-hawk). Both lids are composed of common skin externally, a membrane internally (the palpebral part of the conjunctiva, to be noticed presently), with a layer of fibrous tissue interposed for greater strength. Besides these tissues, the lower lid

has also a smooth oval plate of cartilage to stiffen it. The upper one is raised by a very small muscle, called *levator palpebræ superioris*, arising from the rim of the bony orbit, and running to the edge of the lid. There is no special lowering muscle; it is depressed by the action of part of another muscle, the *orbicularis oculi*, that nearly surrounds the eye, the chief office of which is to pull up the lower lid. The latter has a small distinct muscle for its depression.

A bird's eye, when wide open, appears almost perfectly circular; there are no well marked corners or angles (*canthi*) in front or behind, as in man and most mammals. Birds have no true eyelashes, but some kinds have two series of short modified feathers along the edges of the eyelids, that may be considered to correspond to the hairs found in this situation in mammalia.

Fig. 1.*

Now let us separate the lids and look at the eye. Not yet! "In the twinkling of an eye" a third lid is disclosed inside the other two, throwing a veil over the ball. This third inner eyelid is the nictitating membrane (*membrana nictitans*), a very curious structure, both in its movements and functions. It is a very thin, delicate, elastic membrane, transparent, or nearly so, of a delicate pearly-white color. While the other two lids move vertically, and have a hori-

*Fig. 1, right eyeball, seen from behind, showing the muscles. *a*, rectus superior; *b*, rectus externus; *c*, rectus inferior; *d*, rectus internus; *e*, obliquus superior; *f*, obliquus inferior; *g*, quadratus; *h*, pyramidalis, with its tendon, *k*, passing through pulley in quadratus (as shown by dotted line) to keep it from pressing on optic nerve *i*, then running to the edge of the ball, around which it passes.

zontal commissure, this one sweeps horizontally, or a little obliquely across the front of the ball, from the side next the beak to the outer one. When not in action, it lies curled up in the lower anterior corner of the orbit: when wanted for use it is pulled over the eye by the action of two muscles that grow on the back of the ball. The mechanism of its movements—the most perfect and ingenious that could be imagined—may be clearly understood with the help of the figure on the preceding page, which represents the back of the right eyeball, with all its muscles. Two of these act upon the nictitating membrane alone; *g* is the *quadratus* muscle, so called from its somewhat squarish shape, arising at the upper margin of the ball, and extending down on the ball to the optic nerve, *i*, where it ends in a broad flat transverse tendon, not attached to anything, but perforated so as to form a sheath or loop; *h* is the *pyramidalis* muscle, also so-called from its shape, tapering into a very long thread-like tendon, *k*, that first runs through the pulley-like sheath in the tendon of the quadratus, and then curves downwards and backwards over the ball, to the margin of the latter. It winds around, gets in front of the ball, and goes to be inserted into the lower corner of the nictitating membrane. If this slender tendon went straight along to the margin of the ball, and across the front, it would be right in the line of vision when the nictitating membrane, retiring to its corner, pulled it after. If it went directly under the ball to get to the front, it would not have the right direction to draw the membrane straight across the eye. So it must wind around the optic nerve. But now it would press upon, and interfere with the all-important functions of, the nerve, if there were no provision for keeping it away from the nerve when the pyramidalis exerts its force of traction. Here the quadrate muscle comes into beautiful action; it always contracts simultaneously with the pyramidal, and carries the tendon of the latter up out of the way of the nerve. Such is the ingenious, concerted action, of these two muscles,

which, though contracting in opposite directions, and mutually antagonistic as far as the nerve is concerned, eventually exert their force in the same direction, and work harmoniously for a common purpose. When the tendon of the pyramidalis is loosened by relaxation of the two muscles, the nictitating membrane is set free, and returns to its hiding-place by virtue of its own elasticity, just as the curtain of a coach window, after being forcibly drawn down, rolls itself up again when the lever that sets a spring in action is moved.

We understand the mechanism of the nictitating membrane better than we do its use. Birds can wink with this one eyelid alone, as might be expected from its name, wherein they beat mammals, that cannot wink without moving both lids. If we menace a bird's eye with the finger, we see that the nictitating is the first of the lids to rush to its defence. But the membrane is believed to be chiefly subservient to regulating the amount of light to be admitted to the eye. The eagle is, probably, able to soar aloft directly in the sun's rays, by drawing this covering over its eyes. Owls habitually sit, in the daytime, with drawn curtains to shut out the glare of light. It is also quite possible that many, or most birds that are rapid flyers, make great use of this membrane in guarding against various dangers to which the eye would be exposed in their dashing career. A screen is placed before the eye, which, while not preventing sight, as closure of the outer lids would, opposes the entrance of any particles of matter.

Three lids of the casket that holds the gem have been raised, and yet there is still another covering of the jewel within. A very delicate filmy membrane, not very apparent on ordinary inspection, is laid over the front of the ball, from around which it is reflected over on to the inside of the two outer lids. This is the *conjunctiva*, so-called because it joins the lids to the ball. It is a highly vascular tissue, with numerous tortuous blood-vessels ramifying all through it.

When these vessels become engorged with blood, as occurs in congestion or inflammation of the conjunctiva, they are very distinctly seen, and we have the state of things that is called "blood-shot."

Before examining the eyeball, which at length we have reached, let us glance at some accessory structures that are found lying with it in the socket. Properly speaking, birds cannot be said to cry; their features are immobile, and cannot wear an expression of grief; but they can shed tears. The tears are elaborated by two small glands that lie inside the eyelids, one in each corner. These are both "lachrymal" glands; but the one that lies in the corner next the beak is called the "Harderian gland." It is smaller than the other, nodulated in shape, and deeply seated inside the nictitating membrane, upon which it pours out a viscid or glairy secretion through a small opening, the mouth of a short duct that receives branches from all parts of the gland. The nictitating membrane requires constant oiling to work easily; the Harderian gland is an oil-can that can both make the oil and apply it when needed. The other, more truly a lachrymal, or "tear" gland, pours its secretion into the posterior or outer corner of the eye, near the juncture of the two outer lids, which are thus kept soft and moist on the inside. Tears, in the concrete, viewed anatomically or physiologically, are very different things from tears regarded abstractly as to their æsthetic relations; at any rate, they subserve a much more useful and sensible purpose. The "lachrymal duct," which is neither more or less than a drainage-tube for the eye, to carry off superabundant tears, or tears that have fulfilled their function and are worn out, commences by two little openings in the anterior lower corner of the eye, and runs into the nose, which is thus made a cesspool to receive the refuse waters of the eye. There is, beside the two above-mentioned, a third gland about the eye, very large and conspicuous in some birds, as the loons, albatrosses, and other swimmers, in which it is lodged in a

deep semilunar groove in the roof of the bony orbit. But it does not belong to the eye at all, and seems to be stowed there for want of room elsewhere. Its long duct runs along the top of the orbit into the nose, pouring out a secretion that lubricates the mucous membrane (*pituitary* membrane) of the nasal passages.

The lachrymal glands keep the eye's face clean, and relate chiefly, if not wholly, to the movements of the eyelid. The eyeball itself rolls about by the indirect aid of a different tissue—the *areolar*, or *cellular*, as it is indifferently called,—the interstices of which are filled with fat. Ordinarily, the socket of an eye is much too large for the ball, and of a conical, instead of globular shape, so that the ball can no more fit or fill it, than can a marble dropped into a candle extinguisher. A bird's eyeball is more nearly fitted to its socket than that of most mammals; still, it rests wholly or in great part upon a bed of fat. This soft, yielding, elastic substance gently presses the eye forwards, and holds it there in place, accurately adapted to the lids, while at the same time it allows the ball to rotate any way upon its own axis, and also keeps it greased. We have a great deal of fat in our own eye-sockets in health. The reason that people's eyes are sunken or "hollow" after a long illness, is because part of it is wasted away. While there is so much fat all around the eyeball, there is not a particle in the eye itself; this comparatively clumsy and stupid material would be like a bull in a china-shop in such a nervous quick-witted structure.

Ducks are said to roll their eyes up in a thunder-storm, and very likely they do, since all birds move their eyes about more or less when they are not asleep. But the amount and degree of motion that a bird's eye is capable of is small in comparison with that enjoyed by most mammals' eyes. This results partly from the shape of the orbit, and partly from the shape of the ball itself, which last is very singular, as we shall see in the sequel. Nevertheless, there are as many

muscles in a bird's eye as in a mammal's. They are six in number; whereof four are called "straight" muscles (*recti*) and two "oblique" (*obliqui*); though for the matter of that, they are all of them straight enough. The terms refer to their line of traction. The four recti all arise near each other, at the back of the bony orbit, around the hole (*foramen opticum*) that lets the optic nerve in from the brain; and go to be inserted into the eyeball at four nearly equidistant points around its margin. One (*musculus rectus superior*, *a*, in Fig. 1) goes to the top; another (*m. r. inferior*, *c*) to the bottom, antagonizing the first; the other two (*mm. r. internus*, *d*, *and externus*, *b*) respectively to the front and rear (or to what would be the inner and outer sides, if a bird's eye were directed forwards like ours), and also antagonize each other. The two oblique muscles arise farther forward in the bony orbit, near each other, and then diverge, one (*m. obliquus superior*, *e*) going obliquely upward, the other (*m. o. inferior*, *f*), obliquely downward: they are inserted near the margin of the globe, close by the insertions, respectively, of the upper and under recti muscles. Their action appears to be very limited: the most notable thing about them is that the superior one goes straight from its origin to its insertion, whereas in mammals this muscle changes its direction almost at a right angle, by passing through a fibrous loop, forming a pulley, suspended from the inner upper corner of the orbit, very much as the tendon of the pyramidalis changes its course by running through the sheath in the quadratus. The six muscles serve as so many ropes to pull the eye in different directions, and change the axis of vision; and all taken together, as stays to steady it. In the figure they are cut away from their origins at the bony orbit, and reflected away from the eyeball, to give a fair view of the pyramidalis and quadratus. The reader must mentally collect the six dangling ends, and fasten them in the places above designated.

There are some other structures in the socket of the eye,

besides those already described, and the ball itself. There are nerves, arteries and veins. Of the first named, the optic, or sight-nerve, is by far the largest, and is in fact the only one that can be discerned without more trouble than most persons would be willing to take to see it, and more skilful dissection than most can make. It is described further on, as it can be more conveniently studied in connection with the ball itself. Other nerves go to the muscles of the eye. The *oculo-motor* divides into numerous branches, which are distributed to the inferior oblique, and all the recti except the external. The latter claims a nerve of its own (the *abducens*), and so, also, does the superior oblique, to which the *patheticus* is exclusively distributed. These nerves all come directly from the brain. We do not know why they are so unequally distributed. There are some more nerves in the socket which, however, do not particularly concern the eye, and therefore need not concern us. There is little to be said of the blood-vessels: they ramify everywhere, supplying all the structures of the eye with food. The arteries bring the nutritious fluid, and the veins carry it away when the nourishment has been extracted for the repair of the destruction that constantly goes on in all living tissue, and when it has become loaded with carbon, and other effete or deleterious matter.

So much for the surroundings of a bird's eye,—the setting of the precious stone: now we are prepared to look inside. An eye is a perfect microcosm, in which we find almost every kind of tissue that enters into the composition of the rest of the body. If the reader's interest has been awakened, as we hope it has, by what has gone before, we can, with confidence, invite him to look deeper into a bird's eye, and give him assurance that a far more beautiful "View" will be presented to him.—*To be concluded.*

THE WAVY-STRIPED FLEA-BEETLE.

BY HENRY SHIMER, M. D.

THIS beautiful little beetle, also called "Striped Turnip-fly" (*Haltica striolata* Fabricius) at the West, is well known and abundant. Every gardener is conversant with the fact that like fleas, grasshoppers, etc., it springs away to a great distance when he attempts to put his finger upon it. It appears in early spring, and is a constant annoyance to the gardener during the whole summer.

The Striped Turnip-beetle (Fig. 1) is less than one-tenth of an inch in length. Its general appearance is black, with a broad wavy yellowish, or buff-colored stripe, on each wing-cover. The larva (Fig. 2; 2*a*, pupa) is white, with a faint darkened or dusky median line on the anterior half of the body, being probably the contents of the alimentary canal seen through the semitranslucent skin. The head is horny and light brown. On the posterior extremity is a brown spot equal to the head in size; and there are six true legs and one proleg. In its form and general appearance it somewhat resembles the larva of the Cucumber-beetle, but it is much smaller. Its motion is slow, arching up the abdomen slightly, on paper or any smooth surface, in such a position that its motions are necessarily awkward and unnatural, because in a state of nature it never crawls over the surface, but digs and burrows among the roots in the ground. Its length is .35 of an inch, and breadth .06 of an inch. It feeds upon roots beneath the ground.

Fig. 1. Fig. 2. 2*a*.

The pupa is naked, white, and transforms in a little earthen cocoon, pressed and prepared by the larva, in the ground near its feeding place. This period is short.

From my notes I see that on June 14, 1865, I put a

number of the larvæ into a breeding-box with a supply of their natural food. June 17th, some of the larvæ had disappeared beneath the ground. July 4th, I found in the box the beetle. This gives us seventeen days from the time the larva entered the ground, having ceased eating, until I obtained the perfect insect. I did not open the breeding-box every day, but as the insect was yet quite pale and soft, conclude that it was not more than a day or so out of the ground. The actual time, however, in the pupa state, was less than seventeen days, for, like the larva of the Cucumber-beetle and other beetles, these worms pass a kind of intermediate state, in a quiet, motionless condition, in their little dirt-tombs beneath the ground. During this time they decrease in length very much, becoming a shorter, thicker "grub." This period is a peculiar part of the larval state, and may be called the quiescent, or "shortening period," in contrast with the feeding period. At the end of this preparatory, shortening period, the little larva casts its skin and becomes a pupa.

During the past summer I bred a good number of these beetles from the larva and pupa, taken from their breeding places beneath the ground; but as I took no precise notes of the date, I can say no more regarding the time of the pupa state, except that it is short, only a few days.

Every gardener knows that these insects are very injurious to young cabbages and turnips as soon as they appear above the ground, by eating off the seed-leaves; he also almost universally imagines that when the second, or true plant-leaves appear, then the young plant is safe from their depredations, then the stem is so hard that the insect will not bite it, and the leaves grow out so rapidly as not usually to be injured by them; but if we would gain much true knowledge of what is going on around us, even among these most simple and common things, we must learn to observe more closely than most men do.

The gardener sees his young cabbage plants growing well

for a time, but at length they become pale or sickly, wither and die in some dry period that usually occurs about that time, and attributes their death to the dry weather; but if he will take the pains to examine the roots of the plants, he will find them eaten away by some insect, and by searching closely about the roots will find the larva, grub, worm, or whatever else he may choose to call it; from this he can breed the Striped Turnip-beetle, as I have often done.

I have observed the depredations of these larvæ for ten years, and most of that time had a convincing knowledge of their origin, but only proved it in 1865; since that time I have made yearly verifications of this fact.

Every year the young cabbage plants and turnips in this region receive great damage from these larvæ, and often when we have dry weather, in the latter part of May and early in June, the cabbage plants are ruined. A large proportion of the plants are killed outright in June, and the balance rendered scarcely fit for planting, but when the ground is wet to the *surface* all the time by frequent rains, the young plant is able to defend itself much more effectually, by throwing out roots at the surface of the ground, when the main or centre root is devoured by the larva; but in dry weather these surface roots find no nourishment and the plant must perish.

This year I saw these beetles most numerous in early spring, but have often seen them in August and September, so abundant on cabbages, that the leaves were eaten full of holes, and all speckled from their presence, hundreds often being on a leaf, and at this time the entire turnip crop is sometimes destroyed by them, and seldom a year passes without their doing great injury.

These observations are not entirely in accordance with the teachings of the masters in entomology. From Westwood's Introduction we learn that the Chrysomelians feed on the leaves of plants; that some of them attach themselves to the leaves to transform, and that others descend into the ground

for this purpose, but has no notes of species feeding beneath the ground. Harris was of the opinion that the Striped Cucumber-beetles, in the larval state, fed on the roots of plants, but was never able to find them. I have demonstrated, many years ago, that they feed on the roots of melon, cucumber, squash, and pumpkin vines, and ever since I attempted to raise any kind of vine, my greatest trouble has been *not to find them*.

The Chrysomelians, probably, as a rule, feed on the leaves of plants in the larval state, but in my limited researches I have found the majority of them beneath the ground. According to undisputed authority, they often congregate together in great numbers, and do great injury to the leaves of plants, even so as to compare with the ravages of caterpilars. I myself have observed some of this work.

As the Cucumber-beetle exclusively raises its young on the roots of the Cucurbitaceous (gourd) family, so from these observations I am led to believe from analogy, that the Striped Turnip-beetle raises its young always on the roots of the Cruciferous (mustard) family.

FERNS.*

BY JOHN L. RUSSELL.

THE revelations of the science of geology have made it evident that in the early periods of the earth's history, especially in the formation of the coal beds, the ferns and their immediate allies formed no inconspicuous feature in the vegetation, and that the diminished and dwarfed forms of the present day represent the arborescent ones of that time. But what the present flora may have lost in majesty of size, it has gained in greater variety, and of the elegant and graceful

*A Fern Book for Everybody, containing all the British Ferns, with the foreign species suitable for a Fernery. By M. C. Cooke. Small 8vo, pp. 124. London, 1867.

proportions of many of the modern species, there are few or no traces in the past.

The interest which thus attaches to a fossil impression of an ancient fern, so exquisitely preserved that the venation of the frond (leaf) can be studied as a distinctive character, as well as in a fresh living specimen, cannot fail to render the whole family objects of attention, and help to induce a great many people, both old and young, to know something of its natural history. A taste for ferns has gradually sprung up and extended itself of late, and not a few have become enthusiastic botanists in this single speciality. Others have sought their cultivation as objects of special beauty; and floriculture has not deemed it beneath its domain to introduce them into artistic gardening. The delicate and tender foliage of some species, the fading tints of pale and tender golden yellow on their ripening in autumn, the evergreen lustre of others through snow, frosts and cold of winter, the curious capsules of others, or the grotesque variations of shape in stem and pinnated fronds of still others, have elicited admiration and interest. Wonderfully adapted to the artificial rock-work of picturesque gardening, and enduring, with a becoming hardihood, the changing character of so fitful a climate as ours, many of them, some even of foreign origin, claim the regard of the amateur cultivator. Others more tender and delicate, small and graceful, and of petite proportions, thrive under the ample bell-glass, or in the Wardian case, and help to enliven the parlor window in the wintry season of the year. Rich and costly collections of the fern plants occupy glass structures built expressly for them, and are more attractive in such luxuriance than far more specious and gaudy flowering plants. For it is, doubtless, familiar to the reader that the ferns stand at the head of a very large number of vegetable forms, which can boast of no flowering apparatus, to which neither involucre, nor sepal, neither petal nor stamen, neither pistil nor germen belong! They are the princes of the flowerless realm of

nature, provided with a singularly contrived apparatus, which but faintly and obscurely foreshadows the floral organs of other plants.

It were to be supposed that these plants, so common and widely distributed, would be known to everybody, growing as they do out of the crevices of rocks, springing up in the uncultivated fields, forming immense beds of growing and picturesque vegetation in the pastures, hiding the ground in the swamps, delighting the eye by their tender beauty in early spring, sprouting out in little graceful tufts from the stone walls, nodding and beckoning to their shadows as they are reflected in the water of the shady and cool well, or dipping into the pool or brook, but I have met with those who did *not* know what a fern was, even under its most familiar aspect. For such involuntary or willing ignoramuses, as well as for those who do know something and would know more of the ferns, the little work by Mr. Cooke, is specially and carefully prepared, and is what it purports, a "Fern Book for Everybody;" and well were it if everybody would learn from its humble and unpretentious pages what they can teach: something and enough at least to find the ferns are worth knowing. "It only professes to be a plain and easy guide to the study or cultivation of plants well known, and often described before, hence it contains nothing sensational or new, unless it be an increased effort to be plain and popular, so that persons who know nothing of the science of botany, or its technicalities, may learn something about ferns. Whilst all the British species are described and figured, and hints given for their cultivation, a number of hardy foreign species are also introduced at the close," etc. As several of the genera are common both to Great Britain and to New England, and some species likewise, the figures will materially aid any novice who seeks a cheap and reliable book for his first studies. This point will be farther considered in the succeeding remarks of the present notice.

The ferns are furnished with roots, horizontal or else upright stems, leaves technically called *fronds*, because they are not veritable leaves, and which usually rise from the ground curled up compactly, and gradually uncurling or unfolding and expanding laterally and longitudinally, while on the backs of them little pustules, or else uncovered spots filled or packed with a fine dust, are seen. Almost everybody supposes these dust-like heaps are the *seeds*, but the magnifying lens show that each particle of dust is a curious little casket, or box, or pocket, held together by a jointed and elastic ring. There are many modifications of this arrangement, but in a vast number of instances such is the normal rule. When sufficiently mature and ripe, the ring bursts, and the finer dust is thrown out of the little pocket. Each of these grains of finer dust is, in effect, a small living bud or bulb, and if sown on moist earth, or even on a piece of moistened sandstone, wetted window glass or sandy soil, will soon vegetate and grow, and produce a little dark green thin scale, deeply divided on one side, and when magnified it will be found to be a mesh-work of delicate cells. This scale is called the *prothallus*, and is totally unlike any organ in the higher plants. The prothallus on having obtained its full growth, will have attached itself to the soil or substance on which it has grown, by tufts of minute roots, and in one or more of its tiny cells, a sort of bud has been formed, which presently protrudes itself from its mother cell to meet little bristly-threaded filaments, which are endowed with motion, and which have issued from other nourishing cells on the same prothalline scale. After uniting, the first-named bud or buds grow into tiny stems, having roots of their own, when the scale or prothallus perishes, the young fern pushing forth its leaves, at first very small and unlike the subsequent and normal ones. In a year or more (perhaps even many years) the fronds assume sufficient strength, vigor and size, to make the pustules and heaps of dust on their backs, and the cycle of existence is complete. This

process, which I have often witnessed, is the only blossoming of the fern. It may grow for centuries and become an arborescent kind, such as formerly grew in the Coal periods, and such as now grow in the Sandwich Islands and at the Isthmus of Darien, *but no other blossom or flower appears!*

The dust of rare and valuable ferns collected in foreign countries, and kept closely sealed in phials from the dryness or moisture of the outward atmosphere, and from freezing, has been transported to other parts of the globe, and sown successfully raising living plants for conservatories and collections; those from the tropics being sedulously and carefully cultivated in hot-houses, kept at an uniform temperature the year round. Any one who may have become interested in this matter, may put it to the test by pursuing the plan here described, collecting the ripe dust from such species of ferns as may be within reach.

"That ferns are very beautiful, highly ornamental, and consequently attractive, will be admitted, but the utilitarian will be anxious to learn what are their uses? Such a querist will hardly receive a satisfactory answer if he confines the meaning of his word *use* to market value or to economic application. It is true that the *materia medica* derives small additions from ferns; a kind of food, in extreme cases, has been found in the stems of a very few species, but for clothing or shelter, resin, gum, oil, balsam, starch, dye-stuff, or any other product of the vegetable world which has its use and its market, none of these can be traced to ferns." (pp. 2, 3.)

A singular looking and rather pretty little fern, is the Adder's Tongue (*Ophioglossum vulgatum*), which has an erect stem six to twelve inches high, terminated by a club-shaped head, which is a modified leaf, or frond, and which is made up of the dust-cases or spores, such as usually grow on the back of the frond. Beside this, there is an expanded frond that is barren and devoid of spore-cases, and which looks not unlike the leaf of the dog's-tooth violet when half

grown. The old herbalists abroad attributed to the Adder's Tongue Fern rare virtues of healing, and even the poison of reptiles was supposed to be removed by its use. The Adder's Tongue is a native of this country, and I have met with it plentifully at Plymouth, and also at Hingham, where it was many years ago found by Mr. James S. Lewis of that town, and sparingly, there, in another section of the same town, by myself. The Moonwort (*Botrychium lunaria*) is another genus of the smaller British ferns, its spore-cases being so arranged on a stalk by themselves as to resemble a bunch of grapes. It is known there in this one species, but in the United States we have as many as five, four species besides the British, and several varieties. In England it has proved a difficult plant to cultivate, but I am assured by an eminent amateur in Ferns, that it grows readily when transplanted upon similar grassy land as that from which it was taken. Our *B. Virginicum* is a truly beautiful Moonwort and common in rich woods; and our *B. lunarioides* is subject to many curious variations. The Moonwort was especially a favorite with the witches, and Chaucer speaks of it as a choice herb with alchemists. The Osmund Ferns are showy and conspicuous, abroad represented in the Royal Fern (*Osmunda regalis*), and represented here in a slightly different form, growing, however, in similar situations, and deserving for beauty, grace, and bearing its regal name; beside this, we have two others, the Cinnamon Fern, and the Interrupted leaved Fern, well known to young botanists in the spring. The Polypods are ferns with elongated fronds, of which the common Polypody (*Polypodium vulgare*) is equally a British and a New England species. It is the pretty, evergreen, small fern which grows in matted tufts and beds, in the crevices and chinks of shaded rocks, and is readily cultivated on rock-work. Abroad, at least twenty varieties are known, of which the Saw-leaved (*P. serratum*) is the only one I have noticed growing wild here. Five other species are given, of which the Oak-polypody (*P. dryopteris*) and the Beech

Fern (*P. phegopteris*) are identical with ours. The Parsley Fern (*Allosorus crispus*) is a beautiful and "rather a local species, being found chiefly in mountainous localities in the north of England and Wales. Even there, a stranger may wander day after day and not meet with a plant for several days. The Parsley Fern is a very desirable plant for a Wardian case, or pot culture. It requires a little care in the cultivation, or it is apt to damp off from too much moisture at the roots. The fronds appear in May, and disappear with the early frosts of autumn." (pp. 52, 53.) We do not have this pretty fern, but it is represented in our *Allosorus acrostichoides*, or Rock-brake of Lake Superior, and of the northern and western parts of North America. The Jersey Fern (*Gymnogramma leptophylla*), found only in the island of Jersey as British, "is a little unpretending plant, of not more than two or three inches in height, and is not well suited to the Wardian case, growing most freely in the stove- (or hot) house. A native of Southern and Middle Europe, the isles of the Mediterranean and Northern Africa, it has also been found in Mexico." We are too far north for the Gymnogrammas, known as the Golden and Silver Ferns, and much cultivated for the beauty which a white or yellow mealiness on the back of the fronds gives them. "The Boss Ferns, or as they are sometimes called, Buckler Ferns, include some of the commonest and best known of British species. Their generally accepted botanical name is *Lastrea*. Most of the species are large and easily cultivated in pots or in the open air." Three of these have once divided fronds, four others have twice divided fronds, and one besides has thrice divided fronds. Of these the spiny Boss Fern is represented in our Shield Fern (*Aspidium spinulosum*) and its varieties, and the genus in other species is quite distinct. The British Shield Ferns, in the Holly Fern and Prickly Fern, have representatives with us, and there is one besides which we do not possess, and also another, finer than all, the *Aspidium acrostichoides*, common and beautiful,

evergreen all the year, easily cultivated, and worthy a search for it in shaded ravines and on bushy moist hill-sides. The soft Shield Fern is European, and of "this very sportive fern there are no fewer than sixty varieties, the handsomest of all is undoubtedly the *A. plumosum*, in which the fronds will reach nine inches in width, and nearly three feet in length; it has a spreading, plume-like habit, but is unfortunately a gem which is 'rare' as well as 'rich.'" A very common fern, but one of much delicacy, found with us in moist rich woods, and which in the autumn turns to a rich yellow and fades into nearly white; sought for winter boquets of dried leaves, is, for some unknown reason called abroad, the Lady Fern, and botanically, for a known reason, termed *Athyrium*, on account of a marked difference in the shape of the little scale, or *indusium*, which covers the spore dust on the back of its pretty fronds. It is the *Asplenium felix-femina* of our manuals, and one which is subject to great variation, having been considered, in one condition, a distinct species. It is easily cultivated and much esteemed in England, where it runs into many more varieties than with us, or so because these variations have not been so minutely noticed or carefully recorded. There are "sixty or seventy recognized varieties of this fern which are in cultivation; a few are attractive. The tasselled is one of the greatest favorites; the most singular is known by the name of *Frizellia*, in which the fronds are not an inch in width, with kidney-shaped leaflets divided into two parts, which overlap each other and are toothed at the edges; these are attached to each side of the leaf-stalk." Some pretty lines on this fern run to this measure:

"If you would see the Lady Fern,
In all her graceful power,
Go look for her where woodlarks learn,
Love songs in a summer bower.
But not by burn, in wood or dale,
Grows anything so fair,
As the plumy crests of emerald pale,
That waves in the wind, or sighs in the gale
Of the Lady Fern, when the sunbeams turn,
To gold her delicate hair."

The Spleenworts are all delicate and some are pretty little ferns, so-called on account of some supposed efficacy in the diseases of the spleen. They are technically called *Asplenium*, and although seven of the British species are unknown to our flora, yet we have two that are identical, and seven besides which are not British. The Wall-rue (*A. ruta-muraria*) may be found in our limestone cliffs, at Burlington, Vermont, and Trenton Falls, N. Y., and quite as pretty as in North Wales. The common Wall Spleenwort (*A. trichomanes*) is common about Salem under the shaded rocks of the Great Pasture, and known by its shining black leaf-stalks and simply pinnate oval leaflets. In England where it is plentiful, it is sometimes called the Maidenhair Spleenwort, a "not uncommon species being widely distributed over the British isles, but amongst rocks, old stone-walls and ruins it is most abundant. The walls of loose stones piled on each other, which skirt the roads in North Wales, are often green for miles with tufts of this fern." There are nine or ten varieties in cultivation, the most delicate being the *A. incisum*, the leaflets deeply cut, "each of which is like a fan of spreading, long, narrow lobes." In Scotland this fern had once some repute as a medicine for coughs and colds. For the British Sea Spleenwort, Rock Spleenwort, Bristly Spleenwort, Black Spleenwort, we must content ourselves with the New England and Western Pinnatifid, Ebony-stemmed in two species, the Mountain, the Narrow-leaved and the Thelypteris-like Spleenworts, which will reward the seeker, if haply he may find them all, and of some he cannot fail. But of the Hart's-tongue Fern, "found everywhere, on hedge banks, old walls, on the sides of wells, and in a variety of situations, accommodating itself to the various conditions in which it is placed; easily grown and indispensable both to the out-door fernery and the greenhouse, small plants growing with effect in a closed case;" the Hart's-tongue, I am fain to acknowledge is a very rare American fern, and oftener to be seen in greenhouses than in its native haunts.

It was discovered by Pursh among loose rocks near Onondaga in Western New York, more than fifty years ago; and long unknown until lately found under the limestone cliffs of Chitteningo Falls, in Pursh's locality, and elsewhere as in Canada West. It is a very interesting fern, the frond being like the blade of a knife, auricled or heart-shaped at base, the spore-dots in parallel lines on each side the midrib, reminding you of the Scolopendra, or Centipede, and is easily cultivated and grows readily from spores, as I can testify by actual experiment.

Thus esteemed and common in Great Britain, under cultivation, it has originated a good many varieties, such as the Crisp-fronded, the Crested, the Forked, the Proliferous, the Endive-leaved, the Rugged, the Broad-branched, the Kidney-shaped, and others with minute differences. Those, however, who prefer "nature unadorned" had better turn to Silliman's Journal, for May and September, 1866, and see there a full account of the American Hart's-tongue, identical, though it be, with the British, *Scolopendrium vulgare*, found elsewhere, and also flourishing in the Azores with other interesting species of those islands.

The Scale Fern (*Ceterach officinarum*) "sometimes called Rusty-back, because the whole under surface of the fronds are of a rusty-brown color, from the numerous brown scales which cover them," is a very nice affair, and though "widely distributed," fails us with its presence here. We must be content with many species which fail our British friends, who, so far as the Ceterach, with its ambiguous oriental name is concerned, is better off than we; but in their Hard Fern (*Blechnum*) we have a Southern species which will answer our purpose as well as their own; and then the *B. spicant* of Europe and England, has twenty or more varieties, which must be interesting to the amateur pteridologist or fern lover. The Bracken (*Pteris aquilina*) is a noble fern, only too common with us, who have no wild game and deer to seek a covert among it. The stem cut across exhibits the outline

of a double-headed eagle, as some imagine, whence its name, from *aquila*, or Eagle Fern, an Austrian conceit, perhaps. Its ashes are used by soap boilers and glass manufacturers. A fine native variety of this is the *caudata* of the Southern United States, with the segments, and especially the terminal ones, elongated; and two others beside are Southern. Thus there are three North American "brackens," and a variety in all three, to set against the British one. And as to our beautiful Maidenhair (*Adiantum pedatum*), which grows in the rocky ravines of Danvers, Salem, and its vicinity, we are told that it is "more hardy than the British, succeeding either in the open air or in a greenhouse," but I can aver that the *A. Capillus-Veneris* of England is a lovely fern, and a choice companion for its American sister.

The Bladder Ferns (*Cystopteris*) appear in three species in the British flora, and in two in ours; elegant ferns and easy of cultivation; one, the fragile Bladder Fern, creeping out of limestone and granite crevices alike, and from the interstices of old walls; and a bulb-bearing one furnished with the most cunning little green balls on the pinnæ. I have them both in cultivation, the former British too, but the Royal and the Mountain Bladder Ferns are not represented here; the latter is exceedingly pretty. The *Woodsias* are two, one identical with our own, the *W. Ilvensis*, a hairy little fern, which grows in woolly tufts, so patient of summer droughts on our sunburnt rocks. And against the Alpine Woodsia we must set three that are North American. The British Filmy Fern (*Hymenophyllum*); was there ever anything more delicate "on rocks which are continually moist or subject to the spray of water-falls, and not uncommon in rocky mountainous districts?" but it is principally represented in tropical regions in many species; in England in two, while another British Fern closely related to *Trichomanes radicans*, "on dripping rocks beneath the spray of water-falls, and confined to Ireland," is found in Alabama and Tennessee, with another and tiny species, its minute and

tender fronds sprinkled with spray, which was discovered by Peters, in Alabama, and dedicated to him as *T. Petersii;* occurring also in mosses sent from Pensacola, Florida.

Having thus cursorily glanced at the British types of the fern genera, and compared the species with our own, we leave to the amateur cultivator, to find in our botanical text books and manuals, many North American ferns beside, worthy attention and exclusively native here. That they have, however, received attention abroad, will be manifest by examining the list of "Exotic Ferns" appended to the main work we have had under consideration. In our Climbing Fern, Aneimia, Nephrolepis, Onoclea, Walking-leaf or Camptosorus, Cheilanthes, Pellea, Vittaria, and several Polypodiums, with the golden rhizomed Acrostichum, and the majestic Ostrich Fern, beauty, elegance, grace and novelty will be found.

THE FAUNA OF MONTANA TERRITORY.

BY J. G. COOPER, M. D.

The following notes refer to animals collected or seen in the Rocky Mountains, between Fort Benton, Fort Colville, and Fort Vancouver, Washington Territory, July 1st to November 1st, 1860.

I. MAMMALS.

Bat (*Vespertilio*, species? No. 68 in alcohol). I found this Bat under the bark of a dead tree in Hell Gate valley, over 4,500 feet above the sea. It had been flying about a little in the bright sunlight an hour before it set, but returned to this shelter as if dazzled, though it could see plainly enough where to find a dark place. I saw no other during the journey that I can now recollect.

Shrews (*Sorex, Blarina, etc.*). I mention these here,

merely to remark that at the western base of the Cœur d'Aleñe Mountains, I saw two shrews in one day running swiftly over some of the gigantic prostrate logs of arborvitæ. The day was dark and damp, as is said to be the common climate of that region, and this being the only occasion when I saw any of these animals, during the journey, they had probably been enticed out by the weather. The locality is remarkable for these animals, being about 4500 feet above the sea.

Gray Wolf (*Canis occidentalis*). The Gray Wolf was rarely heard or seen.

Coyote (*Canis latrans* Say). The Coyoté was more common, but none were killed.

Otter (*Lutra Canadensis*). Signs were observed; entirely a cross of this or *L. Californica*, or both, as they are probably identical.

Badger (*Taxidea Americana*). Burrows seen everywhere.

Grizzly Bear (*Ursus horribilis*). None were seen by the party west of Fort Benton, though some below, and the Falls of the Missouri is mentioned, by Lewis and Clarke, as a great resort of this animal. But few tracks were seen, consequently we may suppose it to be rare in the northern mountains, which are almost everywhere densely timbered; and it seems equally scarce in the Great Plain of the Columbia, north of latitude 46°, which is hemmed in on three sides by wooded mountains. Some, however, are doubtless found on the eastern range of the Rocky Mountains.

Black Bear (*Ursus Americanus*). Some bear-meat, obtained at "Hell Gate," was of this species, which is said by the residents there to be very common, and I frequently saw its tracks in the thick woods, which seem to be avoided by the Grizzly Bear.

Richardson's Squirrel (*Sciurus Richardsonii*). I saw no true Squirrel in the eastern Rocky Mountains, though pines were abundant enough to supply them food, but from the vicinity of Hell Gate, westward, even to the summit of

the Cœur d'Aleñe Pass, 5,100 feet above the sea, this squirrel abounded. It seemed to feed on the seeds of every coniferous tree without preference for any one, and obtained the seeds by dropping down the cones, from near the tree tops, to the ground, where it could open them at leisure, usually sitting on a log or low branch to do this, after having bitten off a number of cones. I obtained the best specimens of cones of *Abies amabilis* by the aid of the squirrels, who frequently came down when they saw me looking about the tree, and scolded with the same fearlessness shown by the Chickaree (*S. Hudsonius*) and the more western *S. Douglassii*. Indeed this animal exactly resembles the latter in habits, cries, and general appearance, both differing very little from the Chickaree in these respects. In the cool climate of these northern forests, they seem rarely to build summer nests like the Atlantic species, though such nests are sometimes seen in the branches.

In the Rocky Mountains I found no nuts except those of the pine, even hazel-nuts being absent south of Fort Colville, and acorns east of the Columbia.

Missouri Chipmunk (*Tamias quadrivittatus*). This little Chipmunk I saw in the bare rocky hills of the Mauvaise Territory, fifty miles west of Fort Union, Nebraska, and though I saw none near Fort Benton, I doubt not but they inhabit every rocky locality from Fort Union, west, as I found them again as soon as we reached the foot of the Rocky Mountains, and thenceforward not a day passed without my seeing many of them, until I got fairly out of sight of trees on the Great Plain of the Columbia. I can confirm the remark made by me in 1853, as to the Chipmunks seen in the Yakima valley being of this species, from their color, habits, and want of the shrill alarm-cry of the *T. Townsendii* (like that of *T. striatus* also). But the specimens found on the plains and in the forest differ so much in color and habits, that had I not seen many intermediate shades, I should certainly consider them distinct species; and as I

have never seen them *quite* beyond the range of coniferous trees, I suppose that the smaller, gray or faded, variety inhabiting the extreme edge of the woods, owes its distinction to the influence of more sunlight and heat, combined with inferior food. It is like the half-starved population of an over-crowded region, barely subsisting on what can be picked up on the border of the desert; for, though other rodents thrive on the grass, seeds, etc., of the plains, the Chipmunks evidently require nuts. I have seen them ascend pines one hundred and fifty feet, where they extract the seeds from the cones and carry them off in their cheeks, instead of cutting off the cones like the true squirrels.

Variations in color, connected with exposure to the sun and heat, are noticed also in *T. Townsendii* and *T. striatus*, as well as in other animals, so that much allowance must be made for such influences in the determination of species. The variety found by me in 1863, at the Clickatat Pass, Cascade Mountains, 4,500 feet above the sea, and at first named *T. Cooperii* by Professor Baird, is so nearly intermediate between the form found on the west (*T. Townsendii*) and that east of those mountains (*T. quadrivittatus*), as to suggest a doubt of their distinctness, and at least a suspicion of a hybrid race. (P. R. R. Mammals, VIII, 302.)

Richardson's Spermophile (*Spermophilus Richardsoni*)? On the bare plains between Fort Benton and Sun river, I saw a few specimens of what I supposed to be this animal, and its burrows were numerous in a few spots where the soil was rich, soft, and rather moist. Like other species in Indian countries, it was so very shy that I did not succeed in killing one, but one seen quite near, when I had no gun, agreed in size, color, ears, etc., with the description of the above species, originally found north of Fort Benton.

As every species of this numerous genus I have met with (eight in all) has different habits, even in its mode of burrowing, I may remark that this species prefers soft ground, carries out little earth to the surface, and has several entrances

near together, with galleries communicating at a slight depth. I saw no signs of its burrows in the harder soil which prevails on most of the plains.

Burrowing Squirrel (*Spermophilus grammurus*?). The "Burrowing Squirrel" of Lewis and Clarke, which has so much puzzled both field and closet naturalists ever since their time, was undoubtedly, I think, founded on at least two distinct animals. Their description of the fresh specimen agrees precisely with that given by Dr. Suckley, of *Arctomys flaviventer* (from a recent specimen also), excepting the length of tail, which in the former may have been mutilated, or the length misprinted; otherwise, the words may be paraphrased almost word for word. But their description of the habits of the squirrel indicates quite another animal, whose burrows now exist as abundantly as in their time, throughout the prairies and more open pine woods, from near the summit of Mullan's Pass to Fort Colville, avoiding only the dense forests, and doubtless passing round the Cœur d'Aleñe Ridge, by way of Clarke's Fork and its tributary valleys.

As so well described by them, the burrows occur in villages like the Prairie-dogs, but with several smaller entrances around a central mound of excavated earth, the holes large enough to admit any of the largest Spermophiles. Though abundant, the squirrels are so very shy that I saw only four or five, and if I killed any they got too far down in their burrows to be got out, as all I shot at were sitting at the mouth, and like all these burrowers, their last kick is an effort to get downward. In this shyness they differ wholly from the Prairie-dog, and indeed have far more the habits of a Spermophile. As well as I could see, they had the size, proportions, and color of the species mentioned (*grammurus*), which, according to a specimen label, was found by Townsend on the Columbia river (Baird's Gen. Rep. Mammals, p. 310). Those I saw were silent and watchful, seeming rarely to go far from home, and thus differing much from *S.*

Douglassii and *Beecheyi*, both of them closely allied to it, but which are, on the contrary, very fearless of man, diurnal in habits, and often wander considerably. As before remarked (under *S. Richardsonii?*), all these animals are wildest in the Indian country, though much hunted by whites where they abound. Our guide, Mr. Sohon, tried to get specimens for me through the Indians, but they said it was a very hard animal to catch, and my experience of trials with traps, strychnine, etc., confirms their opinion.

The last burrows I saw of this animal were within fifty miles south of the Spokan river. Lewis and Clarke, in speaking of their villages occurring on all the prairies, may have confounded the burrows of other animals with this (as *S. Douglassii* near the Dalles), and certainly it is not found west of the Cascade Mountains, where they probably got the specimen of Arctomys (?) they describe, as they collected most during their winter residence at the mouth of the Columbia.

Prairie-dog (*Cynomys Ludovicianus.*). The last Prairie-dog village occurred on the plain between Sun and Dearborn rivers, none inhabiting the hills we then encountered, so that I very much doubt their occurrence in Washington Territory, where the "Burrowing Squirrels" take their place.

Yellow-footed Marmot (*Arctomys flaviventer*)? Very near the dividing ridge of the Rocky Mountains, on the east side, I saw an animal, undoubtedly a "Woodchuck," which got into its burrow before I could shoot. Its low broad back, and short flat tail, were very plainly visible, and its color seemed to be dark brown. The burrows often taken for those of the Badger may be sometimes this animal's, as its size and mode of digging are similar. A specimen of this species, preserved by Colonel Vaughan, at Fort Benton, was caught in the Rocky Mountains, thus indicating that the one I saw was probably the same.

Beaver (*Castor Canadensis*). Beavers were seen almost every day, from the steamboat, while ascending the Missouri river, and were remarkably fearless for an animal usually so

shy, sometimes sitting on the bank until the boat got within a hundred yards of them. Their burrows, made in the bank near the mean water level, were, when inhabited, concealed by a large pile of branches, which would have seemed an accidental drift to a casual observer, but if closely examined, showed design in their arrangement, the cut ends all lying above water in one direction, and the others seeming fixed below by sand or clay piled on them.

Near the source of the Little Blackfoot river were many ponds formed by beaver-dams, and I have everywhere noticed that these are constructed in shallow water, probably to deepen it, none being required in larger streams with banks suitable for burrowing in. Beavers seem rarely to build houses in Washington Territory, as they do in colder climates.

Prairie Mouse (*Hesperomys Sonoriensis*). This widely spread Mouse is common at Fort Benton, and was also taken at St. Mary's valley, Washington Territory, in 1853, by Dr. Suckley. Like *H. Gambelii*, and some others, it lives in holes burrowed in the open prairie, far from tree or bush, while *H. leucopus* and *Nuttallii* never seem to leave the woods. Has not this difference in locality caused variations in color, etc., which have led to incorrect specific distinction? (See *Tamias*).

Rocky Mountain Wood-Rat (*Neotoma cinerea*). On the banks of the Missouri, above Fort Union, were frequently seen large nests built in the low forks of willows and poplars, some of them large enough to form a good load for a handcart; probably measuring four feet through, and in form more or less spherical. They were composed of twigs, about half an inch thick and a foot long, dry, and densely interwoven. The soldiers and others called them "Eagle's nests," but finding them without any cavity, and much like the nests of *Neotoma fuscipes* of California in structure (except that that species usually build on the ground), I decided that they were built by the species here mentioned. Dr. Hayden found

it inhabiting the hollow trees on the Yellowstone, and it may build these summer-houses in the branches to avoid the flood which occurs at the breaking up of the ice in spring, the water being dammed up in this part of the river so as to raise it several feet above its banks, and much higher than in the summer rise. From the east base of the Rocky Mountains, entirely across, I found signs of this animal, usually a pile of cactus or other thorny stems, protecting its holes among the rocks, and further west, large piles of twigs for the same purpose. I saw no signs of it, however, in the Cœur d'Aleñe Range or on the Columbia Plains, so that it seems widely separated, locally as well as physically, and in habits, from its nearest relative the *N. occidentalis*, or bushy-tailed Bat, west of the Cascade Range. I did not succeed in trapping, shooting, or poisoning a specimen.

Plain Mouse (*Arvicola pauperrima*, nov. sp.*? No. 126). Great Plain of Columbia, near Snake river, Oct. 9, 1860. If mature, this specimen is certainly distinct from any of the many other species described by Baird and others. I found it common on the Great Columbian Plain, after getting quite out of sight of trees, and where the ground is covered uniformly with a coat of short scattered grass. Its burrows were the only ones observed there, and by looking a few yards ahead, while my horse walked quietly along, I could see many of the little inhabitants sunning themselves during the noonday heat, or running swiftly from hole to hole. The only one I could get was caught in a rut of the road, which was too deep for it to climb out of, though only about three inches.

It was even more abundant on the grassy rolling hills between Snake and Walla Walla rivers, and all I saw seemed to be of about the same size as this specimen. Scarcely any other animal was to be seen where this lived, and water was not to be found for distances of twenty miles, so that in

*Dimensions: head, 1 inch; body, 3.87; tail, vert., 0.75; hairs, 1.00: fore-arm, 0.87; hind foot, 0.62; ear, 0.25×0.38.

summer its powers of enduring thirst must be great, unless it gets enough dew on the grass to supply its wants.

Prairie Hare (*Lepus Townsendii*). This hare is common east of the Rocky Mountains, and was seen on Deer Lodge and other high places west of their summit, but as in 1853 I found none on the Columbian Plain, though the climate and vegetation seems well adapted for them. Their numbers seem never to have increased much north of the Columbia and Snake rivers since the epidemic (small-pox?) destroyed them several years since, but south of those rivers they become common. It is a question whether an epidemic really made them scarce northward, or whether the prevalence of uncommon deep snow did not enable the Indians to kill more of them, as with deer and antelopes.

Sage Hare (*Lepus artemisia*). This small species is more rare near Fort Benton, and I did not see it west of the mountains, except among the Artemisia bushes at Old Fort Walla Walla, Townsend's original locality. Near Fort Laramie it frequents, chiefly, the rocky places where it can hide in holes, not trusting to its speed on the open plains, like *L. Townsendii*, and is therefore very rare, if found at all, on the bare plains. The eastern *L. sylvaticus*, so similar to it as to be scarcely distinguishable, seems to extend its range along the Missouri and Platte rivers. The difference in color, which is the chief distinction, is analogous to that seen in the two varieties of *Tamias*, etc., inhabiting the woods and the plains.

Caribou, or Woodland Reindeer (*Rangifer Caribou*)? About twenty-five miles above the Bitterroot ferry, in crossing a high hill near the river, I noticed by the roadside a pair of decayed and broken horns, which looked like those of the Woodland Reindeer, before reported to inhabit the Northern Rocky Mountains, and from which a district of British Columbia has been named Caribou. These horns were more slender and elongated than that represented by Baird (Mammals, p. 634), but he remarks that scarcely any two pairs are alike.

American Antelope (*Antilocapra Americana*). Very abundant along the upper Missouri, and to the Rocky Mountains. Some were also seen west of the summit in Deer Lodge Prairie, and probably frequent all the larger plains as far as the Bitterroot Mountains. West of these, however, it seems to be very rare. In Washington Territory, though, I was informed by Capt. Fraser, U. S. A., that an old hunter, living at Spokan river (Antoine Plante?), once got lost in the Great Plain, towards the most westerly bend of the Columbia, a region uninhabited, and almost unknown to the Indians; that he there saw large herds of Antelopes. Also, that they were formerly abundant on this plain, but that during a very deep snow, some years since, the Indians slaughtered hundreds of them (as before reported of the deer), since which time they have been scarce. This is quite likely since snow is sometimes quite deep on portions of these plains, and since the introduction of fire-arms the Indians have killed more game. There seems to be some foundation for the belief that the horns of these Antelopes are deciduous, from the fact that some which I have seen had the terminal and outer layers of horn peeling off like a sheath, but this may not be a constant occurrence.

Rocky Mountain Goat (*Aploceras montanus*). The Rocky Mountain Goat is almost unknown to the traders at Fort Benton, but Mr. Dawson told me that skins were now and then brought in there, coming from the Bitterroot Mountains, near the sources of the Kookooskee, one of the loftiest portions of the central chains, and from which rivers flow in all directions. The summits there are above the line of perpetual snow, and just below this is a zone of grassy country inhabited by these animals, while still lower the densest forests prevail, totally unsuited for them, and extending more than 5,100 feet above the sea, the height of the Cœur d'Aleñe Pass. This animal is quite unknown to hunters who have spent their lives in the mountains south of latitude 42°, though its almost inaccessible resorts are so little visited,

even by them, that it may exist there. Maj. Haller, U. S. A., told me that the Indians near Wenatchy river, in the Cascade Mountains, catch them in the deep snow by rushing down upon them from above, on snow-shoes. As they always look for danger from below, this mode of surprising them is not improbable, and besides, these mountain animals run up hill much more easily than down.

Mountain Sheep (*Ovis montana*). The Bighorn is common in the rugged bare hills along the Missouri, from Fort Union west, and throughout the Rocky Mountains to the Cœur d'Aleñe Range, but since the time of Lewis and Clarke seems to have disappeared from the cliffs bordering Snake and Columbia rivers, probably on account of the use of fire-arms by the Indians.

The Buffalo (*Bos Americanus*). Last summer (1860) the Buffalo herd of the upper Missouri was spread from the Rocky Mountains, near latitude 49° south-east, and we found them along the Missouri from its upper Great Bend west to about fifty miles above Milk river, but nowhere in great numbers. Remains of their skeletons, left about five years since, were abundant west of Fort Benton, and I saw one or more old skulls daily in the valley of the Little Blackfoot and Hell Gate rivers, quite down to the junction of the Bitterroot. Large herds have sometimes visited the west side of the summit, especially Deer Lodge and St. Mary's valleys, but not for many years past. If they ever reached the Columbia Plains, it was probably by way of Snake river, as they would scarcely try to cross the Cœur d'Aleñe Range, where grass is very scanty and the timber very dense. I saw no difference in the skulls, indicating a different species, or "Mountain Buffalo" of the hunters. (The Bighorn is sometimes called so.) The horns showed that most of the animals were very old bulls, being enormously thickened, and their lower part scaling off. This accounts for the large size and solitary habits of these "Mountain" specimens.

EARTHQUAKES.

BY W. T. BRIGHAM.

EARTHQUAKES and volcanoes are at last claiming, by their very intrusive activity, the attention of observers, who are able to look through the smoke of an eruption, and the dust of an earthquake, at the real geological importance of the terrible demonstration. Within the past two years the earth has been strangely unquiet. First Vesuvius sputtered forth feebly in its old age; then Santorini smoked and steamed, and extended its little territory; then Central Europe shook a little, and the tremor extended through Asia, and into the Pacific, where a new island came to the surface near the Samoan Group. All these were but premonitions, and last spring, while the vibrations were being repeated on the eastern continent, the huge volcanoes of the Hawaiian Islands broke forth with a violence unknown there for centuries. The earth heaved and opened, the craters of Kilauea and Mauna Loa poured forth their lava streams, and finally the sea rushed upon the shore destroying animals and men. To this day the island shakes, but the movement is so slight that little notice is taken of it. Not so remarkable as this Hawaiian earthquake, nor so admirably adapted for scientific research, but far more destructive to life and property, was the terrible earthquake of the South American coast this summer. The commotion was so violent, that the impulse given to the sea extended through the whole Pacific, reaching even to the coast of Kamtschatka.

While the scratches of the pebbles, frozen into a block of ice, claim and gain the attention of geologists, strangely enough, the far mightier forces which build up those mountain ranges, and which have modified much of the earth's crust, are comparatively neglected. It is true that M. Alexis Perrey, in France, has collected since 1842, all evidence attainable relating to earthquakes, which he has published

in annual catalogues; and Robert Mallet, in England has collected similar evidence in his "Catalogue of Recorded Earthquakes, from 1606 B. C., to A. D. 1842," and has done a very important work in his investigation of the great Calabrian Earthquake of 1857. With these exceptions, very little of importance has been done to investigate the causes and seasons and effects of earthquakes; and geologists do not as yet know whether the shock is caused by the falling of huge masses of rock into subterranean caverns, by the explosion of gasses pent up in the bowels of the earth, by the evolution of steam when water reaches the heated interior of the globe, by the surges and tides of an inner molten sea, acted upon by the moon's attraction or terrestrial revolution, by the gradual contraction of the earth's cooling crust, by the waxing and waning of the internal heat locally, by some unknown law, or by any of the other causes so ingeniously suggested, most of which are as probable as the subterranean convulsions of an imprisoned Titan.

Catalogue makers have to trust to evidence which has become more or less distorted in passing through many hands; they do not see for themselves. When an earthquake takes place, everybody is caught unprepared, and if not killed, yet so terribly frightened, as to be wholly unfit to describe events exactly as they took place. The evidence of one good observer, who examines the ground after it has all passed, is of more value than a score of newspaper reports at the time. But our geologists all live far away from earthquake countries, and only a return to the shakes, which took place in New England a century ago, will wake them up to the importance of seismic* studies. Let us not feel too secure among our granite hills.

New England has been visited by a number of earthquakes since the Pilgrims landed in 1620. The first was in 1638, and twenty years later occurred what is called a "great earthquake," but no descriptions have been preserved. In

* *Seismic* means relating to earthquakes; from *seismos*, an earthquake.

1663 (February 5), a severe shock was felt in Canada, New England, and New York, severe enough to open and shut doors, ring bells, split walls, and let floors fall through; and while the first shock continued nearly half an hour, a most uncommon thing, the secondary shocks continued at intervals until July. In 1727, an earthquake occurred in the territory between the Delaware and Kennebec rivers, centreing, apparently, near the Merrimack river. Springs changed their place, and some dried up; the water in wells was rendered turbid and unfit to drink, so that people pumped the wells dry thinking some carrion had fallen in. November 18th, 1755, a shock threw down about a hundred chimneys, and about fifteen hundred were shattered more or less in Boston. The ends of twelve or fifteen brick buildings were thrown down from the top to the eaves of the house. The duration of the shock was nearly four and a half minutes. On the same day the sea withdrew from the harbor of St. Martin's, in the West Indies, leaving vessels high and dry, and on its return the waves rose more than six feet above high-water mark. This was nine hours after the shock was felt in Boston. Since then no severe shocks have been felt in New England, although a band of extinct volcanoes extends through its midst, curving from Montreal to New Jersey.

These gentle breathings of Mother Earth become terrible gasps and spasms in other regions, and as examples of her terrible power, the earthquake of Lisbon, and the repeated shocks of the Andean region, may be here recalled.

November 1st, 1755, about half past nine in the morning, a sudden subterranean noise was heard, and in a few seconds the principal buildings of Lisbon were in ruins. It was a *fete* day, and the churches were crowded; the high steeples and the solid walls fell together, and thousands of people were crushed beneath the ruins. People in the upper stories of the houses were generally more fortunate than those below, or in the streets, but it was believed that sixty thousand perished on this terrible day in Lisbon. To add to the hor-

rors of the scene fire broke out among the ruins, a violent wind arose, and in about three hours the city was reduced to ashes. Immediately after the shock, a huge wave entered the Tagus, forty feet higher than the water had ever been known to rise before, but the bay received most of its violence, and it at once subsided. The quay was thronged with people, and it suddenly sank, and no body ever floated to the surface. Where the solid wall had stood the water was many fathoms deep. At Cadiz the sea wave was nearly sixty feet high, and did great damage. According to Humboldt's computation, a portion of the earth's surface, four times greater than all Europe, was simultaneously shaken; even our great lakes felt the commotion, and tides of considerable height were observed on their shores.

During the years 1811–12, earthquakes were felt in South Carolina, and more violently in the valley of the Mississippi, where, at New Madrid a whole grave-yard was pitched into the river; and the violence finally culminated in the destruction of Carracas, burying ten thousand of its inhabitants beneath its ruins. In 1835, an earthquake was felt between Copiapo and Chiloe on the north and south, and the island of Juan Fernandez, and the city of Mendoza, on the west and east. Conception, Talcahuano, Chillan, and other towns were thrown down, and immediately after the shock the sea retired in the Bay of Conception, and the vessels grounded where had been seven fathoms of water. A wave soon rushed in and retreated, and was succeeded by two others probably not more than sixteen or twenty feet in vertical height. In November 1837, Valdivia, in Chili, was destroyed, and in January of the same year a shock devastated Syria, destroying more than six thousand people, and making itself felt over a territory five hundred miles long by ninety wide.

The earthquakes, then, of the present year are no novelties, however dreadful they may seem, but they offer many interesting features, and although no scientific man has yet published any account of the earthquake of St. Thomas, that

of the Hawaiian Islands, or of Peru, it may be well to briefly recount the facts.

At St. Thomas no less than five hundred shocks of earthquake were felt, from the middle of November to the second of December, 1867. The inhabitants had abandoned their houses, and dwelt in tents on the hill-sides. November 18th was a clear, beautiful day, the ocean was almost calm, and the sun was bright and warm. Not a sign foretold the approaching catastrophe, when at a quarter before three in the afternoon, the usual underground rumbling was heard as of distant thunder, and immediately the earth rose and fell in small waves for about a minute, while the subterranean noise was dreadful. No one could stand. The sun seemed to have lost his power. After the first shock, the ground kept quivering for about ten minutes, when another strong shock was felt. Before the first shock, the ocean had receded several hundred feet from land, and it now returned as a huge, straight, white wall, smooth and even as a wall of masonry, and eighteen to twenty-five feet high. It moved with considerable velocity, upsetting all small craft, and raising large vessels to its top. The lower part of the shore was submerged to a depth of two or three feet, and to a distance of two or three hundred feet inland. An even larger wave succeeded this, at an interval of about ten minutes, and as this passed away, the ocean remained calm as before the first shock.

At St. Croix, the U. S. steamer Monongahela was thrown high and dry upon the shore. The waves receded rapidly, and at once rose in a wall nearly thirty feet high, white as snow, and hissing with spray. This huge wave carried everything before it, and it was repeated several times with nearly equal violence, when, as at St. Thomas, the sea became quite still.

Between 4 and 5 o'clock, P. M., on Thursday, April 2d, 1868, an earthquake occurred on Hawaii, centreing on the southern slope of Mauna Loa, far severer than before re-

corded on the group. Houses were destroyed, cliffs hurled down, fissures opened in the ground, the whole earth seemed in violent motion, and an earthquake wave drove the sea over the southern coast in places to a height of twenty feet, sweeping away all the shore villages. Five days later lava broke out on the higher slopes of Mauna Loa, and flowed into the sea. Kilauea, at the moment of the great earthquake of April 2d, began to empty itself by some subterranean channel, and is now five hundred feet deeper than in 1865. This whole eruption and earthquake, more remarkable than any of the others of the past year, deserves a fuller description than can be given here. The newspaper reports are filled with errors and misstatements.

Finally, in this series of disturbances, we have the terrible earthquake which, on the 13th of August last, caused so great destruction of life and property on the coasts of Chili, Peru, and Ecuador. At Arica, lat. 18° 30′ S., long. 70° 25′ W., the rumbling sound as of distant thunder, so usual a forerunner, preceded this earthquake, and almost immediately the rocking motion of the earth commenced. Houses trembled with increasing force, until they fell in crashing ruin. The earth opened in several places in almost regular clefts from one to three inches wide, and as these closed they sent a cloud of dust to mingle with that from the falling buildings. Gas of a most suffocating nature, came from these fissures, and had it remained long, all animal life must have perished, but after three undulations, each severer than the preceding one, the cloud of dust and gas which overhung all, dispersed, and the light again appeared. The gas remained in all about a minute and a half. Quakes at short intervals succeeded, and subterranean explosions, and now all the survivors fled to the hills, taking their most precious property, for the sea was fast receding, and they well knew the terrible consequences of that unnatural tide. Soon the current changed, the ocean came back in a huge wall of water, dragging with it all the vessels, among them the large U. S. steamer Wateree

which was landed almost uninjured about four hundred and fifty yards inland. The other vessels did not fare so well: dashed ashore, keel upmost, they remain a sad spectacle, the prey of the wreckers. On shore less than a hundred people lost their life, while on shipboard nearly three hundred perished. At Iquique the shock lasted over four minutes, and was followed by the wave which destroyed at least three-quarters of the town and many lives. At Arequipa the earthquake commenced a few minutes past five in the afternoon, and in a few moments nearly every house in the town was in ruins. The cities of Yca and Pisco suffered severely, and at the Chincha Islands both the earthquake and the tidal wave did great damage. At Callao the wave went over the houses on the shore at 10 o'clock, P. M. These were much damaged, but no lives were lost. At Talcahuano, and Torne, near Conception, three shocks occurred, a day later according to the reports, and the second caused, or was followed by a tidal wave, which nearly destroyed the towns. From Cape San Francisco, in Ecuador, to the Straits of Magellan, nearly every seaport town has suffered, and at the northern end of this coast line, among the mighty volcanoes of the equator, the records report several towns in ruins, among them Ibarra, San Pablo, and Atuntaque, and where Catacachi stood is now a lake of water. No less than thirty thousand inhabitants of these towns perished with their homes.

Let us close this sad catalogue of disasters, where man seems so utterly powerless to cope with the vast forces with which God's plan of creation is carried on, with a brief review of some of the former earthquakes, which have rendered this region so noted.

According to Ulloa, in 1570, along the coast of Chili, an earthquake and tidal wave was felt which extended three hundred leagues along the coast. In 1575 Valdivia was destroyed. January 22d, 1582, at noon, Arequipa was destroyed, and four years later, at Callao, a tidal wave four-

teen fathoms high followed a severe quake, and extended two leagues inland. In 1600, Arequipa was covered with ashes from a neighboring volcano. In 1605, November 26th, Arequipa was destroyed, and the sea overwhelmed Arica, leaving a few streets only. In 1678, at Santa, some 5° N. of Callao, the sea retired a long distance, returning with great force, and destroyed the town. Four years later Pisco was destroyed by a tidal wave. Six years rest, and Pisco was again inundated, and in 1690, after a very violent shock, the sea retired six miles, and after three hours returned with such rapidity that the fleetest horses could not save their riders; the earth sank, and where the town stood is the present harbor. In 1705, Arica was destroyed by a tidal wave, and ten years later was nearly overturned with Arequipa and other towns by earthquakes. The next year, 1716, the town of Pisco, which had been rebuilt farther inland, was again destroyed, and now not by a tidal wave, for although the sea was so agitated that masts and yards of vessels were shattered, it did not pass its bounds. July 8th, 1730, Conception was destroyed by an earthquake and tidal wave. At Callao in 1746, a severe earthquake was felt, and the tidal waves were of great size; of twenty-three vessels then in port, seventeen were sunk, and four carried inland above the town, which was levelled by the waves. Of four or five thousand inhabitants, only two hundred survived, and on the second advance of this vast wave, only a portion of the wall of the fort, which preserved twenty-two persons, remained. In 1773, at Copiapo and along the coast, the earthquake claimed 45,000 victims. May 15th, 1784, Arequipa was overturned, and several districts hitherto arid, produced springs of water, so abundant as to form navigable streams. In 1828, at Callao, an English vessel, the Volage, found the water boiling about her, and exhaling a great quantity of sulphuretted hydrogen. Many dead fish floated; on weighing anchor portions of the cable twenty-five fathoms from the ship, lying on a bottom of soft

mud, were found partly melted. Arica this time wholly escaped, although the shocks were felt all over Peru. In 1831, after nearly a century's rest from any fatal shocks, Arica was destroyed for the fifth or sixth time since the landing of the Spaniards, some three hundred years since. These are only the most severe shocks which have disturbed this region. Others, that anywhere else would attract attention, here pass almost unnoticed. Indeed it has been said that the Andes are continually quaking in some part, although severe shocks have seldom visited the eastern slope.

The volcanoes nearest the cities of Arica and Arequipa are of great height; *Sahama*, near the former, being 23,914 feet, while *Miste*, near the latter, is 18,877 feet high, and frequently in gentle eruption.

With such an array of terrible results, it would be hard here to insist, with any chance of being believed, that earthquakes are, by no means, nuisances, and, that on the contrary, they are portions of God's operations in Nature most beneficial and useful. The tides of the ocean are useful, that every one knows, although they leave bare and pestilent marshes and flats; and these irregular tides of the land have none the less their uses in breaking up and altering the surface of the earth, changing watercourses, altering the shoreline, and in other ways, whose description can hardly be condensed into the limits of this article.

REVIEWS.

THE VARIATION OF ANIMALS AND PLANTS UNDER DOMESTICATION.*— These volumes are the first of the suite promised by the author in his work on the "Origin of Species," and are filled with facts of his own observa-

*The Variation of Animals and Plants under Domestication. By Charles Darwin. Authorized (American) Edition, with a Preface by Professor Asa Gray. 2 vols, 12mo, pp. 494 and 500. Published by Orange Judd & Co., 245 Broadway, New York.

tion, and extensive quotations from all the authorities upon the various races of domesticated animals. The author's general argument may be inadequately given as follows: That since "all organic beings increase at so high a ratio, that no district, no station, not even the whole surface of the land or the whole ocean, would hold the progeny of a single pair after a certain number of generations," "the inevitable result is an ever-recurrent struggle for existence." In other words, a contest for growing and feeding room in which "the strongest ultimately prevail, the weakest fail." "If, then, organic beings in a state of nature, vary even in a slight degree," "the severe and often-recurrent struggle for existence will determine that those variations, however slight, which are favorable, shall be preserved or selected, and those which are unfavorable shall be destroyed." Thus if by any chance a male is born stronger than his fellows, he will prevail in the battles of the breeding season, and raise offspring having a certain advantage, also, over their fellows in point of strength, and thus this variation will gradually accumulate until the peculiarity which distinguished only one individual, becomes common over large areas, and perhaps universal to the species.

Again if an individual vary in any way which may give it a better chance of surviving in the general struggle, this variation is likely to become permanent, since a greater number of this favored race would survive and transmit their peculiarities to their offspring. Thus a constant progress is maintained, the structures varying and gradually departing from their original types by this infinitely slow process of improvement by evolution, until new species, new genera, and new families arise. This process is called natural selection, showing that nature does her work of progressive improvement in organic beings, as the breeder does among domesticated animals, by the destruction or exclusion of the inferior individuals, and the pairing together only of the strongest and best.

Darwin's opponents say on the other hand, that a species is an invariable type, and that the variation of individuals does not accumulate, but fluctuates between certain limits. The inevitable conclusion being that there is no progress by the evolution of one form out of another, but that each species is a creation directly from the hands of God.

The anti-Darwinists lay great stress upon the tendency of cultivated plants and animals, especially when allowed to run wild, to revert, in their characteristic markings, to the original wild types. We are disappointed that so little is said upon this point in the volumes under review. Unquestionably the doctrine of reversion bears two interpretations in the present state of our knowledge, according as one considers it subordinate or more powerful than the tendency to variation. The anti-Darwinist takes the last view, and attributes the different races of domestic animals, with their great anatomical differences, to the power exercised by man in rendering tendency to reversion powerless while he increases the tendency to variation; thus artificially sustaining and producing races which could not have occurred under the action of natural

laws, since among wild animals the two tendencies would mutually counteract each other, keeping the species within its own proper boundaries of form and variation.

The only really notable instance about which the author seems to entertain no doubt, is the Porto Santo rabbit. This animal, though differently marked in some respects, and not more than half the weight of the English rabbit, yet recovered the peculiar markings of the English species in rather less than four years after its transportation to England. Thus in a feral state, under a different climate, it lost the characteristic colors and weight of its species, and returned to the colors only when brought to its native climate. They were found while in the Zoölogical Gardens to be extremely wild and active, more like large rats in this respect than rabbits, and untamable; and the two males, though bachelors, utterly refused to pair with the native breeds; "yet this rabbit, which there can be little doubt would thus have been ranked as a distinct species, has certainly originated since the year 1420."

One would think that an instance of this kind would unquestionably prove the efficiency of change of climate, and the external surroundings of the species in producing a revolution in its characteristics. Natural selection could have had nothing to do with the return of the characteristic markings of the species after its return to England, since they were the same individuals, and not their offspring, which reverted. Yet, Darwin (p. 337) is disposed to attribute the change which took place when the species was transported to Porto Santo, rather as due to reversion and natural selection, than to change of climate. If so, why did change of climate produce the reversion to its ancestral colors when it was transported to England, and why is the hot insular climate of Porto Santo deemed inadequate to produce a similar result? A cause similar to that which produced the change of color in so short a time, would certainly seem adequate to produce the change of size and habit in the time which elapsed since the year 1420.

The proposition that the laws which govern the propagation and inheritance of characteristics among domesticated races, are the same as those which obtain among wild animals, is supported by a classification of the pigeons, in which the several stocks are traced back through intermediate types to Columba livia. The author, also, adds that in this classification "the same difficulties are encountered and the same rules have to be followed as in the classification of any natural but difficult group of organic beings." The novelty of the fact, however, consists in this, that the several races, the Pouter, Fantail, Carrier, etc., differing from each other to an extent which only those who have seen them can appreciate, are traced, with more or less probability, back to one common ancestor. Perhaps none of Darwin's experiments and researches will excite the attention of the systematic zoölogist more than this. That man has been unable to destroy the laws of affinity as they exist among natural groups, while he has so radically modified the form and character of the original species, is a significant fact. If true, we can no longer assert that man

can reverse or denaturalize the action of these laws among domesticated animals, but simply change the direction of their action. Thus he may make them produce any given series of forms which are possible in the organization of the progenitor, but all these forms will be related to each other, and must be classified in the same way as a natural series of feral animals.

In the second volume, after showing that inheritance of structure and habits must be considered the rule, except when "overborne by hostile conditions of life, by incessantly recurring variability and by reversion," the author states this very important law. "At whatever period of life a new character first appears, it generally remains latent in the offspring until a corresponding age is attained, and then it is developed. When this rule fails, the child generally exhibits the character at an earlier period than the parent. On this principle of inheritance at corresponding periods, we can understand how it is that most animals display from the germ to maturity such a marvellous succession of characters."

Naturalists universally acknowledge that, during their development, animals pass through certain changes or stages of growth, during which they acquire characteristics resembling the peculiarities of the adults of more simply organized species. This law has hitherto only been ascertained in the larger groups in a general way, or if applied to smaller groups has been used only to settle disputed points of classification. In an article recently published, Mr. Hyatt has applied this embryological law to the classification of the fossil Ammonoids, even to species of closely allied genera.*

His observations, however, differ, having been made upon species instead of individuals, in this important particular: namely, that which is accidental with the immediate offspring, the earlier appearance of a new characteristic, is the law and not the exception between the species, and in some quite closely allied shells, such as *Androgynoceras hybridum*, *A. appressum*, *Liparoceras Henleyi*, and *L. Beechei*, certain characteristics are developed at earlier periods in each succeeding species of the series, and finally omitted altogether. This and similar instances led him to the conclusion that "the young of higher species are constantly accelerating their development, and reducing to a more and more embryonic condition, or passing entirely over the stages of growth corresponding to the adult periods of preceding or lower species." We should look, therefore, upon this earlier occurrence of characteristics, among individuals, not as an accident, but as probably a law. Without it we cannot see how any room, on the basis of Darwin's theories, can be obtained in the life of any individual or species, for bringing to maturity those characteristics which especially mark it as an advance in the line of progress.

To account for the various phenomena of the inheritance of character, features, diseases, and injuries at corresponding ages in the offspring, and reversions, we have the doctrine of Pangenesis.

* Memoirs of the Boston Society of Natural History. Vol. I, Part II. On the Parallelism of the Individual and Order in Tetrabranchiate Cephalopods. By A. Hyatt.

According to this theory, each cell in every part of an animal is supposed to be capable of throwing off an infinite number of gemmules, or organic units, at every stage of its development. These gemmules are conveyed from the parents to the embryo through the medium of the sperm and ovule. In this way the development of characteristics, at corresponding ages, is readily accounted for. These gemmules are capable only of producing cells like those from which they were derived, and thus they continue to live in the circulation until the proper age for their development into cells enables them to join in building up the body. They would then be drawn together, as we understand it, by a sort of natural affinity, and reproduce the tissues of the part from which they were derived. Under adverse circumstances, certain classes of these would not be developed but lie dormant in the organization, though still transmitted from parent to child, until in some remote individual they would find the proper opportunity for development, and produce a reversion. While this theory appears to satisfy nearly all the conditions of inheritance, there are certain cases which Mr. Darwin, with his usual candor, admits are inexplicable. Those instances in which certain varieties of plants can be propagated by buds, but revert in the seedling, this occurring especially with hybrids, and "certain plants with variegated leaves, phloxes with striped flowers, barberries with seedless fruit, can all be securely propagated by the buds or cuttings; but the buds developed from the roots of these cuttings almost invariably lose their character, and revert to their former condition."

It is the misfortune of a science in the transition stage of its history that all theories can only be approximations to the truth. The old and the new theories of life are no exceptions to this rule, and the minds of naturalists are distracted by two views, apparently equally uncertain. Darwin, with all his erudition and extensive research, is unable to remove the main difficulty in the way of the doctrine of evolution. He is obliged, in his "Origin of Species," to assume the miraculous creation of four primary types, and only by analogy does he consider himself justified in referring these four types back to one common ancestor. This part of the argument he candidly confesses is weak and unreliable. Darwin, also, wisely avoids any reference to the origin of life itself, and when he has arrived at the four primary types, and even by analogy at their single progenitor, the reader is still as far as ever from knowing where and how they came into being.

As yet, all attempts to produce living beings, of even the lowest organization, from inorganic compounds have failed, and in all cases where spontaneous generation is said to have occurred, the Bacteriums, Monads, etc., have appeared in a fluid which was impregnated with some vitalized compound.* Life is not necessarily extinguished by the heat to which these fluids were subjected, or else why is it that cooked food, which has been subjected to any heat short of absolute combustion, is capable of convey-

* A Word on the Origin of Life. By Professor J. D. Dana. Silliman's Journal, May 1866.

ing more or less of its former store of vitalized matter into the digestive organs? These experiments, however, do not justify the unbiassed mind in coming to any conclusion. They have been made with great care and thoroughness, but until a series of similar attempts, with all the modern appliances and safeguards, has been tried upon matter which is not derived in any way from previously vitalized compounds, it is not safe to say either that life can or cannot be produced by spontaneous generation. The key-note to the theory of the origin of species, the doctrine of evolution, would appear to be the origin of life, the beginning of evolution, and this theory, however true it may be in its minor applications, is very far from completion when it rests upon a basis of four primary types, or even one whose origin is doubtful.

On the other hand, the theory of miraculous creation, by which it is believed that every species is separately created, rests upon negative evidence. It is alleged that the ancestry of no one species has as yet been traced to a specifically distinct progenitor, and that the same species do not usually cross any of the great gaps in geological time, thus giving to each set of beings, which successively inhabited the surface of the earth, the appearance of a new, independent creation.

These two, grand, negative arguments, are the buttresses of the theory, but it is hardly necessary to say that they are not conclusive. The basis they afford is liable to be shifted by any new investigation, since it is not inherently improbable that species may have specifically distinct progenitors, or that they pass from one geological formation to the other, but only the first has not been traced, and the last is still a disputed question.

To complete the elements of confusion and uncertainty, we have no fixed meaning to the word species, which is the key-note to the dispute. While all know that a naturalist means a certain initial division, all the members of which are *supposed* to be, on account of their resemblance to each other, the descendants of a common ancestor, there is no test of this consanguinity. It thus becomes in practice a matter of personal judgment, whether we select a larger or a smaller initial division, and call it a species, though it makes a vast difference in the result. If we regard slight differences as sufficient to characterize the species, we are drawn towards the view that each is separately created; if, however, greater latitude is given, the varying forms thus supposed to have a common ancestry are strong supporters of Darwin, and his laws of inherited variability. It is, perhaps, this uncertainty, and the desire of almost all minds of the nineteenth century, to look for secondary causes, whose modes of action may be determined by experiment, rather than to refer to the direct interposition of the Creator, that has caused so many converts to Darwinism.

The present volumes are, besides their value to the philosophical naturalist, a condensed statement of facts with regard to domesticated animals, and bring the agriculturist and zoölogist face to face in a way which we cannot but hope will prove beneficial to both. Whatever may be the errors of theory, the facts are judiciously classified, faithfully and can-

didly given, both for and against the author's opinions, and cannot but prove of great value to every unprejudiced reader.

In conclusion we may remark that no fear of scientific technicalities need deter any one from procuring these volumes. They convey a vast amount of instruction in a thoroughly comprehensible garb.

FIELD, FOREST, AND GARDEN BOTANY.*—We are glad to be able to announce the approaching issue (if not already in the market) of a work upon botany, of a character so likely to meet the wants of amateurs, whether botanists or gardeners, as well as of those who make either botany or gardening a profession, and indeed of every one who likes to know the name of a common plant of our region, either wild or cultivated. It is a book from which everything is left out that is not directly conducive to the easy determination of the name of a plant we may happen to have in hand, and one in which all reasonable facilities, in the way of copious Analytical Keys, Index, and typographical arrangement are introduced for this very purpose. Although 2,650 species, under 947 genera, are described with more or less of detail, yet those who use this book must not be disappointed if they do not find the rarer native plants mentioned. They must turn to the "Manual" for those, and it would be unreasonable to suppose that every plant from foreign parts, which we may cultivate, is described in a book of less than 400 pages. As already intimated, however, all our common wild plants which are worthy of notice, and all the more generally cultivated garden and hot-house plants, are here described in terms, from which, so far as it is possible, all technicalities are eliminated, and all synonymy is left out.

A special advantage that the book offers is, that it will enable students and teachers of botany to use in their study and teaching, exotic plants which will often present forms of structure that are not represented at all in our fields and woods, or even introduce the knowledge of whole natural orders, which are otherwise beyond their reach, without recourse to extensive botanical libraries. The use of this book will also enable the study to be carried on in winter with much greater facility than ever before.

Another feature of the work will be very acceptable to many persons, and that is the part concerning the ferns, contributed by Professor Eaton of Yale College. All our common native ferns, as well as those usually cultivated, are described so as to be easily determined by any one who is familiar with the meanings of the few technical terms necessarily used, and who reads with care the characters of the Natural Order.

As the author says in his Preface, "the great difficulties of the undertaking have been to keep the book within the proper compass, by a rigid exclusion of all extraneous and unnecessary matter, and to deter-

* Field, Forest, and Garden Botany; a simple introduction to the common plants of the United States, east of the Mississippi, both wild and cultivated. By Asa Gray, Fisher Professor of Natural History in Harvard University. New York: Ivison, Phinney, Blakeman & Co. Chicago: S. C. Griggs & Co. 1868. (Reviewed from advance sheets.)

mine what plants, both native and exotic, are common enough to demand a place in it, or so uncommon that they may be omitted." Should it be found that the descriptions of more cultivated plants are wanted by those who use the book, we are half promised that "if the book answers its purpose reasonably well, its shortcomings, as regards them, may be made up hereafter."—H. M.

ANNUAL REPORT OF THE TRUSTEES OF THE MUSEUM OF COMPARATIVE ZOÖLOGY.*—By the present report it appears that this Museum, with its great store of specimens, requires to be enlarged in order to become useful to the public, and also requires that the annual income of $10,000 should be about doubled in order to carry on the work of publishing, and the internal arrangement of the collections. We hope that the grant of the Legislature, during their last session, will more than supply this want. The director presses upon the trustees the claims of scientists to a partial use of the collections, which in their present state are not available to investigators. The work done this year seems to have been wholly for the preservation of the collections, with the exception of Dr. Wilder's dissections of the Selachians, and Mr. Leo Lesquereux's labors on the Fossil Plants. Dr. Hagen, although at work in the Museum, seems to have contributed nothing to the present Report. We quote from Mr. Lesquereux's report the following remarks on American Fossil Botany:

"The few vegetable remains, for example, obtained from the Tertiary of Tennessee and of Mississippi, and from the Cretaceau formation of Nebraska and California, have demonstrated facts, which science was scarcely prepared to admit:

"First. That the floras of our ancient formations already had peculiar types, which separated them from each other in the different continents. This is even evident in the vegetation of the Coal measures. Therefore, the supposition of a continental union of Europe with America by Atlantides or other intermediate lands, is proved to be untenable.

"Second. That the essential types of the old floras, of the cretaceous and tertiary formations have passed into our present vegetation, or are preserved to our time. The Cretaceu of America, for example, has already the Magnolias, which we find still more abundant in our Tertiary. This last formation has furnished a number of species of the genus Magnolia, nearly identical with that now existing in the United States, while the genus is totally absent in the corresponding floras of Europe. More than this: we find in our Tertiary the same predominating types marked on both sides of the Rocky Mountains. On the Atlantic slope, leaves of magnolias, of oaks, of elms, of maples and poplars, and not a trace of coniferous trees; while in California and Vancouver Island, the red woods or Sequoia, abound in the Cretaceau and Tertiary, as now they still form the predominant vegetation of the country. These few facts are mentioned only to show the importance of collections of fossil plants from every formation of our American continent, the only part of the world where questions of general significance concerning palæontological distribution can be studied with some chances of satisfactory conclusions."

NATURAL HISTORY OF BIRDS.†—There is at present great need of an elementary work on Ornithology, treating of the general principles of the science, written in popular language, and adapted to the wants of learners. The preparation of such a work seems to be the design of the authoress of "Lectures on Ornithology," Part I. of which we have already received.

* Annual Report of the Trustees of the Museum of Comparative Zoology. Report of the Director, 1867. 8vo, pp. 22.

† Natural History of Birds. Lectures on Ornithology. In ten parts. By Grace Anna Lewis. Philadelphia: J. A. Bancroft & Co. Part I. 12mo, pp. 32. 1868.

This treats of general principles, and is to be understood as being introductory, while the remaining parts will be devoted to the structure and further classification of birds; their general habits and instincts; the relations of their *habitat* or residence to physical causes, and to their geographical distribution; to which is to be added "a briefly descriptive catalogue of the birds of the Middle States," and "of many of the most beautiful or remarkable birds of the world." It is designed, also, to devote special attention to the structure and exquisite colors of the plumage, and the microscopic character of the downy covering of the young; a field of research as yet hardly approached, yet full of interest, and of practical value to science.

In this first part the writer very appropriately devotes several pages to an account of the structure of the egg, and the mode of development of life within it, and subsequently notices the differences noticed in the external form of the egg as seen in the different groups, and the peculiar variations in the color and texture of the shell. The greater part, however, is devoted to a discussion of the classification of birds; a new or considerably modified system of which is proposed. It shows that the writer has given the subject considerable thought, and is in many points highly commendable, in fact approaching in general more nearly to the natural system, than several of the classifications recently proposed by our (reputed) highest authorities. We scarcely see the propriety, however, of making a third sub-class of the Ostrich and the Dodo, and their respective allies, nor of dispersing the Præcoces so widely among the Altrices, as is done, not only in the present case but generally. The subdivision, by Oken (according to Agassiz, by Bonaparte as generally received), of birds into two grand divisions, be they sub-classes or orders, seems to have been a truthful and important recognition of two very natural groups, the subsequent mingling of which seems only to tend to prolong confusion. The parallelisms between the two groups pointed out by Professor Dana, or the occurrence of representative groups in each, seems strongly to corroborate their naturalness.

Miss Lewis's modestly written book, however, seems likely to supply a gap in our ornithological literature, and as it bears unmistakable marks of originality, and promises a clearly expressed epitome of the present state of the science, we heartily commend it as a work fully entitled to generous patronage.*—J. A. A.

REVIEW OF THE SCANDINAVIAN PUBLICATIONS IN NATURAL HISTORY DURING 1867 AND PART OF 1868.† (In a letter from Dr. Lütken of Copen-

* The Naturalist's Book Agency will supply this work at 35 cents a part.

† Dr. C. F. Lütken, an accomplished naturalist and assistant in the Royal Zoological Museum, at Copenhagen, has kindly consented to prepare for the NATURALIST, a yearly review of the progress of Natural History in Scandinavia, of which the following interesting report, to be concluded in the next number, relates to the literature of Denmark and Norway. The conclusion, embracing Sweden and Finland, will follow soon. As these works are rare and generally inaccessible, containing papers by the most thorough and reliable observers in Northern Europe, we think the readers of the NATURALIST are especially fortunate in securing such reports from the fountain head of natural science in Northern Europe.—EDS.

hagen, dated October 1, 1868.)—According to your request, I have the honor of laying before your readers a short summary of the latest scientific contributions of Scandinavian naturalists, to the progress of those departments of science to which your esteemed journal is devoted; but the limited space likely to be allowed to such a review will permit my giving little more than the titles of the papers. Nevertheless, I entertain the hope that it will be sufficient to show that the part taken by Scandinavian naturalists in the common work of the advancement of science, is important enough to justify the increasing attention bestowed upon this branch of scientific literature in later times abroad, especially in England and America; and I may be permitted to add, that nowhere ought the Scandinavian literature be better known. The Scandinavian tongues, and especially the Danish, enter so largely into the composition of the English language, that it must be a comparatively easy task for an American to make himself so far familiar with our language, that their rich literary treasures may not be unintelligible mysteries to him.

Permit me to begin with the scientific productions of my own country, with which I am of course best acquainted. Of papers falling within the limits of this review, the *Oversigt over det Kongelige danske videnskabener Selskabs Forhandlinger*, for 1866 and 1867 (Proceedings of the Royal Danish Academy of Science), contain the following: First, a critical essay from the pen of the Secretary (Professor Steenstrup), "On some of the more important results of the diggings made in the French bone-caves during late years," containing many important suggestions, but perhaps most worthy of serious attention by its opposing strongly some commonly diffused notions about the supposed contemporaneity of man and certain extinct animals, *as an established fact*. The author will only yield to positive material evidence of man's existence at a given epoch, deduced from his treatment in definite manner of the bones of the animals hunted, or from his having made unquestionable and authentic figures of them; and such arguments are as yet almost absolutely wanting; the "bare evidences" are rejected as utterly useless in this respect. Professor Reinhardt has described and figured (on two plates) three new species of *Characinoids* from Lagoa Santa, Brazil (*Piabina*, new genus, *argentea* Reinh., *Characidium*, new genus, *fasciatum* Reinh., and *Parodon Hilarii* Reinh.). In the French "resumé," attached to this paper (as in fact to almost all the papers of the "Proceedings," for the purpose of making them more intelligible to foreigners), the author adds some interesting remarks on the geographical distribution of the Brazilian freshwater fishes. Mr. Reinhardt has brought home from the Rio San Francisco, but especially from its tributary, the Rio das Velhar (Minas Geraes), twenty-five species of *Siluroids*, twenty-six of *Characinoids*, four of *Gymnotoids*, and two of *Sciænoids*. Fourteen other fishes have been described from the same water-basin by other naturalists, and four more were mentioned by the residents of the country, but remarkably enough, there is not a single *Chromid*, though the adjoining waters are richly stocked with species of this family. Professor Hannover has given an abstract of his

researches on "the microscopical structure and development of the dermal teeth (scales and spines) of the *Chondropterygii*." The memoir is printed in full in the Transactions of the Academy, and illustrated with four plates and some figures in the text. French resumés having been added both to the Memoir (at least to the copies separately printed), and to the paper in the "Proceedings," I shall confine myself to mentioning that the author has established four types of placoid dermal teeth according to the shape of the cells: the "conical" (dorsal spines of *Raja batis*), the "knoll-like" (scales of *Carcharias* and *Chiloscyllium*), the "net-shaped" (spines and scales of *Trygon*), and the "bundle-shaped" cell (*Pristis*). A chapter is added on the dental structure of the dermal plates of *Ostracion*, and a detailed description is given of some very enigmatical comb-like corneous bodies, preserved in the museums of Copenhagen, Christiana and Kiel, but of unknown origin: from their resemblance in microscopical structure to the dermal spines of skates, the author is inclined, I think, hardly with sufficient reason, to ascribe them in some way to this order of fishes.* Professor Johnstrup has discovered in the old Danish part of our neighbor-kingdom, at Annetorp, in the vicinity of Malmo, in Scania, a new locality for that remarkable limestone formation, termed the "Faxoe-limestone;" it is one of the youngest links of the Cretaceous formation in Scandinavia, and is extremely rich in fossils, being in fact a great fossil coral growth. At Annetorp the relations of this second deposit of Faxoe-limestone to the other stages of the Chalk formation are clearly indicated and have confirmed the position previously assigned to it. Professor Lange reviews the species of plants figured in the forty-sixth part of the "Flora Danica," and Professor Œrsted continues his curious experiments, demonstrating that certain fungi, parasitic on different species of plants, and described as distinct genera and species, are in reality only the *alternate generations of one species*. This he showed to be the case with *Podisoma Sabinæ* infesting the branches of the Savin, and *Ræstelia cancellata* (on the leaves of the pear), while *Podisoma clavariæforme*, residing on the branches of the juniper, manifests itself as the first asexual state (or generation) of the *Ræstelia penicillata* (lacuata), which gets its livelihood from the leaves of the apple and the white thorn; and *P. juniperinum*, inhabiting also the branches and leaves of the juniper, is in the like manner reduced to the corresponding form of the *Ræstelia cornifera* (cornuta), infesting the leaves of the Sorb (Mountain-ash). You will remember that the specific identity of *Puccinia graminis* and *Oidium berberidis* was in the like manner demonstrated some years ago through the almost contemporary experiments of De Bary and Œrsted, thus confirming the opinion for a long time fostered by farmers, but rejected as superstitious by most naturalists (Sir Joseph Banks excepted), on the obnoxious influence of the Barbary on the corn-fields.

* A few months since, Professor Baird placed in our hands a singular bony plate, received by him from Professor Jenks, the locality of which was unknown. From a microscopic section of this specimen we came to the conclusion that the plate must have belonged to some part of an unknown placoid fish; and from the slight description of Professor Hannover's specimen, we believe ours to be the same. — Eds.

During the last two years two volumes have been issued of the Transactions of the Royal Danish Academy of Science (Vols. VI. and VII). They contain the following memoirs: Professor Hannover's Observations on Encysted Helminths in the Frog (with two plates), and on the Structure and Evolution of Scales and Spines in the Cartilaginous Fishes (spoken of above); Professor Johnstrup's Monograph of the Manner of Formation of the Faxoe-limestone, and its later alterations; Dr. Krabbe's Helminthological Researches in Denmark and Iceland, especially on the Echinococcus disease in the latter country; Dr. Bergh's Anatomical Contributions to the History of the Æolidiaceæ (with nine plates); Professor Œrsted's on a peculiar, hitherto unknown, manner of Evolution in certain Parasitic Mushrooms, especially on the genetic connection between the Podisoma of the Savin and the Rœstelia of the pear tree, and finally Dr. Gottscher's Monograph of the Hepatic Mosses of Mexico, described from the collection of the late Professor Liebmann. As most of these papers had been published separately before 1867, or have already been referred to above, it will be sufficient to direct the attention of botanists to the last-named voluminous memoir, by one of the first authorities on the subject. It is written in Latin, and illustrated by twenty plates, mostly representing species of Plagiochila. More than two hundred species of Hepaticæ were collected by Mr. Liebmann, and three-fourths of this number were new to science. In the Scientific Contributions from the Society of Natural History, for the years 1866 and 1867, you will also find various papers on Zoölogy and Botany. Dr. Krabbe forwarded two papers on Helminthology. In the first he treats of certain undeveloped nursing forms of Tænia, and their presumed corresponding mature species, namely, the so-termed *Gyporhynchus pusillus*, from the mucus of the intestine, and from the gall bladder of *Tinca*, in which the author has recognized the "nurses" respectively of *Tænia macroplos* (from *Ardea nycticorax*), and *T. corrylaneristata* (from *Ardea nivea*). *T.* (cysticercus) *arionis* (limacis) is probably the immature condition of *T. multiformis* of the Stork; and the miniature tape-worm observed by Stein in the *Tenebrio molitor* is identical with the *Tænia murina* of rats and mice as first suggested by Küchenmeister.

In a second paper Dr. Krabbe has described and figured the tape-worms of the bustard, *T. villosa* Bl., and *Idiogenes otidis*. The latter new genus is especially distinguished by the peculiar wing-like dilatations of the sixth and seventh anterior segments (the head). Dr. Bergh has continued his researches on the anatomy and systematic distribution of the Gymnobranchiate and allied Mollusca by the description and anatomical investigation of two species of *Phidiana* (P. inca D'Orb., and P. lynceus, new spec.). The accessory eye discovered in the latter species occasioned a closer investigation, and a refutation of the presumed epipodial eyes in Margarita, described by Mr. Agassiz. The author also strongly combats the fecal theory of the urticating corpuscles in Æolidiaceæ. In another part of the paper he describes a parasitic Crustacean (Ismaila monstrosa) found on *Phidiana lynceus*, and allied to, or at least analogous, to

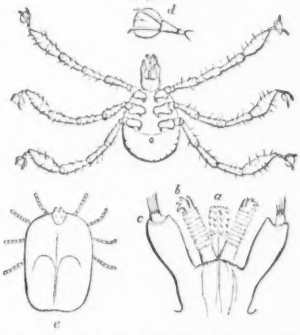
Splanchnostrophus. Some notes on the latter genus, and on an Acarus, parasitic on *Galeina rupium* are added. Mr. Mörch has given a detailed account of the Mollusca of the Faroe Islands (Cephalopods, three species; Brachiopods, one species; Gasteropods, sixty-five; and Bivalves, forty-two species), illustrated by an instructive tabular synopsis of the geographical distribution of the Mollusks of Iceland and Faroe.

NATURAL HISTORY MISCELLANY.

ZOÖLOGY.

THE MOOSE TICK.—On the 13th of April a pair of young moose were brought through New York on their way to Europe. They were raised in Nova Scotia, and being very tame, were allowed to run at large. The cow moose would ramble off in the woods, and while there, had become infested with ticks; the bull had escaped contact with these insects. When the cow arrived in New York, her sides and back were almost covered with adult ticks. The insects were removed very much to the relief of the animal, and the ticks were placed in a bottle without food or water. On the 1st of May they commenced to lay eggs, and continued to do so until the 25th of June, when they died. The eggs are forced out in large masses. On the 3d of July, the day after I sent the drawings to you, the entire mass of eggs seemed to hatch out at once, the shell opening like a clam, and releasing a six-legged insect.—W. J. HAYS.

Fig. 1.



[The specimens sent us by Mr. Hays are very interesting, as showing that the young tick has only three pair of legs instead of four, which all adult spiders and mites (*Arachnida*) possess. This is a strong argument for the supposition that the Arachnids form an order in the class of insects, and not an independent class. Fig. 1 *e* represents the adult tick, drawn by Mr. Hays. The six-footed young has enormous legs, and the head is separated from the hind body, where in the adult it is sunken in the thorax. *d*, shows the claws, with a broad sucking disk beneath, enabling it to adhere to objects. On the right is a magnified drawing of the mouth parts of the young; *a*, is the labium, armed with hooks; *b*, the maxillæ, probably, also armed with powerful hooks, and *c*, the mandibles. Thus armed, the young tick buries itself in the flesh of its victim.—EDS.]

EXCHANGES.

SHELLS.—I wish to exchange Land and Fluviatile Shells of the United States, with persons residing in other districts. Also, Marine Shells for Land and Fresh-water Shells.—H. FREEDLEY, *Norristown, Pa.*

LEPIDOPTERA.—The rarer species of Catocala (especially *C. relicta*) are desired in exchange for American Lepidoptera by JAMES ANGUS, *West Farms, N. Y.*

The rarer species of American Moths (especially *Geometridæ*), are desired by the MUSEUM OF THE PEABODY ACADEMY. Native and exotic insects will be sent in exchange.

TO LEPIDOPTERISTS.—I respectfully solicit from lepidopterists the use of any new and undescribed species of North American butterflies for publication in "The Butterflies of North America." Specimens will not be injured by the artists, and will be returned to the owners in as good order as received. Parcels sent to the care of J. H. Hunt, 52 Walnut Street, Cincinnati, O., will be duly forwarded to me. It will give me pleasure to name specimens of which any collector is in doubt, or to exchange. I especially desire to obtain, either by exchange or purchase, specimens from the far Western States and Territories or from British America.—W. H. EDWARDS, Post-office address, *Coalburgh, Kanawha Co., W. Va.*

ANSWERS TO CORRESPONDENTS.

S. J., Wyoming, Luzerne Co., Pa.—Your specimens came perfectly. They are fungi of the order of the Puff-balls, and belong to the genus *Geaster* Mich. The species we cannot determine at this moment, and it might require some study. The *Geasters* are rather rare,—Cooke reckoning but nine species found in Great Britain. They are closely allied to the common Puff-ball, but more curious and elegant in form. No use is known for them, nor are they supposed to be at all poisonous. It will be worth while to look for more.—C. M. T.

W. H. E., Coalburgh, West Va.—The phosphorescent larva enclosed is the young of Photuris Pensylvanica (see fig. 2, p. 432). It is our most common luminous larva, and we have identified it since the note on p. 432 was written.

H. S., Mt. Carroll, Ill.—The moth is a species of Depressaria. We should be much obliged to any of our readers for specimens of the cattle and horse ticks. They are to be found in the early part of summer, especially in the South-western States.

J. M. H., Kalamazoo, Wis.—During cloudy weather moths and butterflies secrete themselves during the day in grass and among leaves and similar hiding places. They are all very susceptible to the sunlight, and do not fly, as a general rule, in cloudy days.

W. C. F., Eastham, Mass.—Your fish is the rare little "One-spotted Dory," of Dr. Storer's Report (p. 78, pl. 14, fig. 2), *Argyreiosus unimaculatus* of Batchelder. Dr. Storer says that the only specimen he has seen was taken in Boston harbor, Oct. 1847. Mr. Batchelder's specimen was taken at Saco, Me. Your fish is of about the same size as the other two known specimens. Has your fish any eggs, or does it appear to be young?

W. W., East Windsor, Conn.—The larva is *Phobetrum pithecium*, one of the silk-worm family, though a very singular form.

H. H. K., Spencer, Mass.—For a brief notice of the froth-insect, which makes the "toad-spittle," see Vol. I. of the NATURALIST, p. 327.

W. H. K. L., Kansas City, Mo.—We return the insect, which is the *Belostoma Haldemanum* of Leidy.

BOOKS RECEIVED.

The Butterflies of North America; with colored drawings and descriptions. By. W. H. Edwards. Philadelphia: Published by the American Entomological Society. Aug. 1868. 4to, with five plates. $2.00.

Hawaiian Club Papers. Boston, 1868. 8vo.

American Bee Journal. November. Washington.

Canadian Entomologist. Vol. I, No. 3. Toronto. 8vo.

Cosmos. October 3, 17. Paris.

American Entomologist. Vol. I, No. 3. St. Louis.